

LCD MODULE SPECIFICATION

Model:	UE013QV-RH13-L002C
Version:	V1.0
Date:	20220316

Customer Confirmation 客户确认

Approved by	Notes

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REVISION HISTORY

Revision 版本号	Date 日期	Contents of Revision Change 修改内容	Remark 备注
V1.0	20220316	Preliminary release	All

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1. GENERAL INFORMATION

1.1 Features

- 1) Pixel Arrangement: RGB Vertical Stripe
- 2) Interface Mode: 4 Wire SPI
- 3) Driver IC: GC9A01
- 4) Operation Temperature: -20~70℃
- 5) Storage Temperature: -30~80℃
- 6) Backlight Type: White LED
- 7) Display mode: Normally black,
- 8) Pixel Density: 261 PPI
- 9) LED life time: 30,000 Hours

1.2 Mechanical Specification

Item 项目	Specification 规格	Unit 单位	Remark 备注
Pixel Driving element	IPS TFT	-	-
Screen Size	1.28	Inch	Diagonal
Resolution	240(W)*3(RGB)*240(H)	Dots	-
Interface	4 Wire SPI	-	-
Module Power Consumption	0.278	Watt	Typ.
Active Area	32.4 (∅)	mm	-
Pixel pitch (W*H)	0.135(W)*0.135(H)	mm	-
Module Size (W*H*D)	35.6(W)*37.74(H)*1.56(D)	mm	-
Luminance	450	cd/m ²	Typ.
Viewing Direction	All	O'clock	-
Display Color	262K	Colors	18 Bits

2. ABSOLUTE MAXIMUM RATINGS

Item 项目	Symbol 符号	Min. 最小值	Max. 最大值	Unit 单位	Remark 备注
Power supply1 voltage	VDD	-0.3	4.6	V	Note1
LED Reverse Voltage	V _R	-	5	V	For each led,Note1
Operating temperature	T _{op}	-20	70	°C	Note1,2
Storage temperature	T _{st}	-30	80	°C	Note1,2
Humidity	H _{st}	10	90	%RH	Note1,3

(Ta=+25°C,DGND=AVSS=0V)

Note1:If the module exceeds the absolute maximum ratings, it may be damaged permanently. Also if the module operates with the absolute maximum ratings for a long time, the reliability may drop.

Note2: In case of temperature below 0°C,the response time of liquid crystal (LC) becomes slower and the color of panel darker than normal one.

Note3: Temp. ≤ 60°C , 90% RH MAX.

Temp. > 60°C , Absolute humidity shall be less than 90% RH.

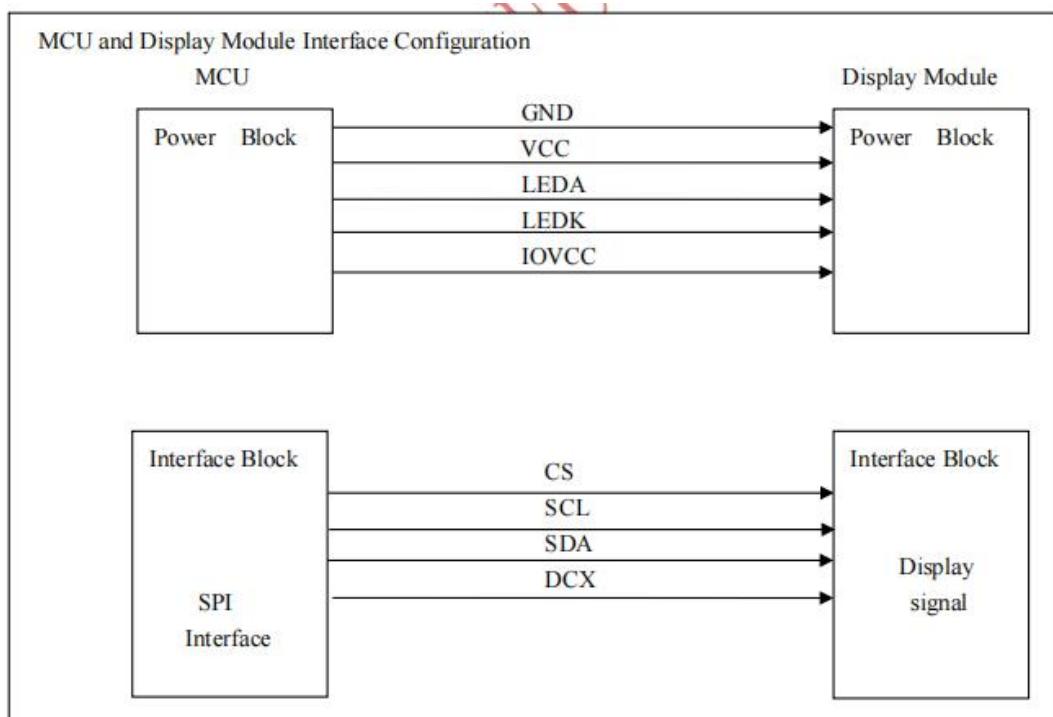
4. I/O CONNECTION & BLOCK DIAGRAM

4.1 I/O Connection

Pin No. 序号	Symbol 符号	I/O	Description 描述
1	VCC	P	Power supply for analog circuits
2	GND	P	Power Ground
3	VDDIO	P	Power supply for backlight cathode
4	GND	P	Power Ground
5	SPI_CS	I	Chip select pin for SPI interface
6	SPI_CLK	I	Clock select pin for SPI interface
7	SPI-MOSI	I/O	Data select pin for SPI interface
8	DCX	I	D/C select pin for SPI interface
9	RESET	I	The signal will reset the LCM, Signal is active low.
10	GND	P	Power Ground
11	TE	O	Tearing effect outputsignal. If not used, please let this pin open
12	LEDK	P	Power supply for backlight cathode
13	LEDA	P	Power supply for backlight anode

I: Input; O: Output; P: Power

4.2 Block Diagram



5. ELECTRICAL CHARACTERISTICS

5.1 TFT-LCD Panel Driving Section

Item 项目	Symbol 符号	Min. 最小值	Typ. 典型值	Max. 最大值	Unit 单位	Remark 备注
Power Supply1 Voltage	VCC	2.5	2.8	3.3	V	
Power Supply2 Voltage	IOVDD	1.65	1.8	3.3		
Power Supply1 Current	I _{VDD}	-	50	-	mA	Note1
Power Supply2 Current	I _{IOVCC}		10			
Logic Input High Voltage	V _{IH}	0.7IOVCC	-	IOVCC	V	-
Logic Input Low Voltage	V _{IL}	0	-	0.3IOVCC	V	-
Panel Power Consumption	P _{VDD}	-	0.158	-	Watt	Note1
Module Power Consumption	P _{LCM}	-	0.278	-	Watt	Note1,2

(Ta=+25°C, DGND=AVSS=0V)

Note1: Measurement Conditions (Video Mode): Full Screen Red Pattern, VDD=3.3V, 60Hz Refresh.

Note2: P_{LCM} = P_{VDD} + P_{BL}, About P_{BL} information, inference to 5.2 Back Light Driving Section.

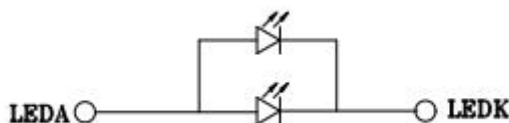
5.2 Back Light Driving Section

Item 项目	Symbol 符号	Min. 最小值	Typ. 典型值	Max. 最大值	Unit 单位	Remark 备注
Forward Voltage	V _F	-	3	-	V	Note1
Forward Current	I _F	-	40	-	mA	Note1
Backlight Power consumption	P _{BL}	-	0.12	-	Watt	Note1
LED life time	-	30000	-	-	Hrs	Note2
LED Quantity		2			PCS	

(Ta=+25°C, DGND=AVSS=0V)

Note1: The LED driving condition is defined for

Note2: The “LED life time” is defined as the module brightness decrease to 50% of original brightness at I_{LED}=20mA(Per Led). The LED life time could be decreased if operating I_{LED} is larger than 40mA.



5.3 Power On/Off Sequence

6 level modes are defined they are in order of Maximum Power consumption to Minimum Power Consumption:

1. Normal Mode On (full display), Idle Mode Off, Sleep Out.

In this mode, the display is able to show maximum 262,144 colors.

2. Partial Mode On, Idle Mode Off, Sleep Out.

In this mode part of the display is used with maximum 262,144 colors.

3. Normal Mode On (full display), Idle Mode On, Sleep Out.

In this mode, the full display area is used but with 8 colors.

4. Partial Mode On, Idle Mode On, Sleep Out.

In this mode, part of the display is used but with 8 colors.

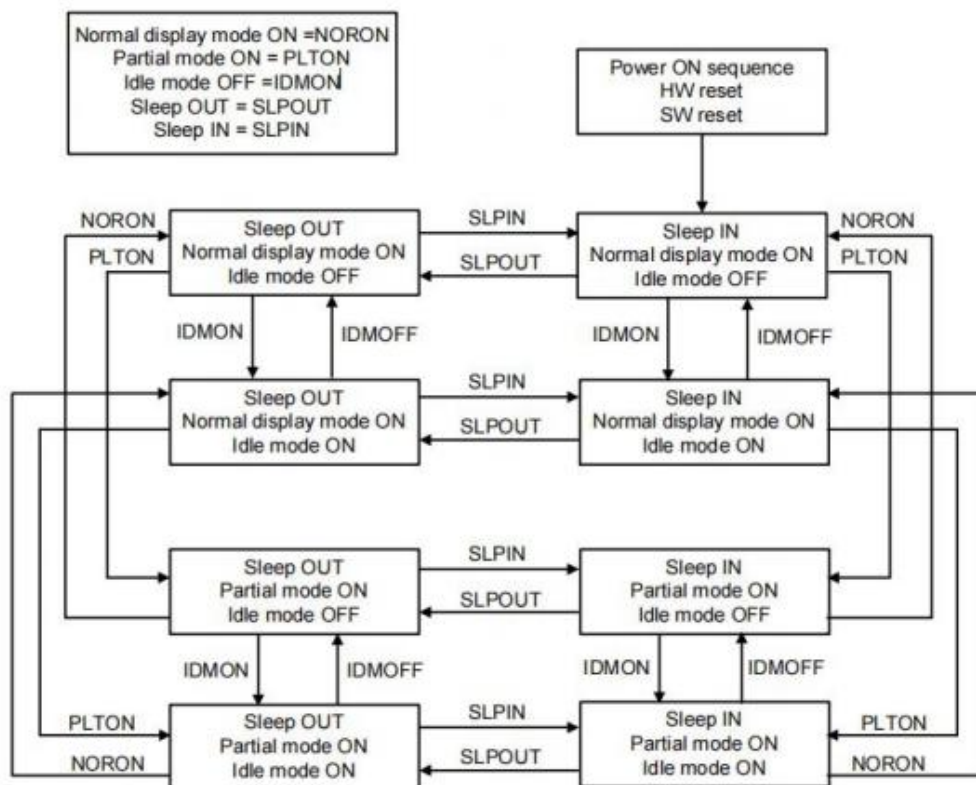
5. Sleep In Mode.

In this mode, the DC : DC converter, Internal oscillator and panel driver circuit are stopped. Only the MCU interface and memory works with VDDI power supply. Contents of the memory are safe.

6. Power Off Mode.

In this mode, both VDDB and VDDI are removed.

Note1: Transition between modes 1-5 is controllable by MCU commands. Mode 6 is entered only when both Power supplies are removed.



Note 1: There is not any abnormal visual effect when there is changing from one power mode to another power mode.

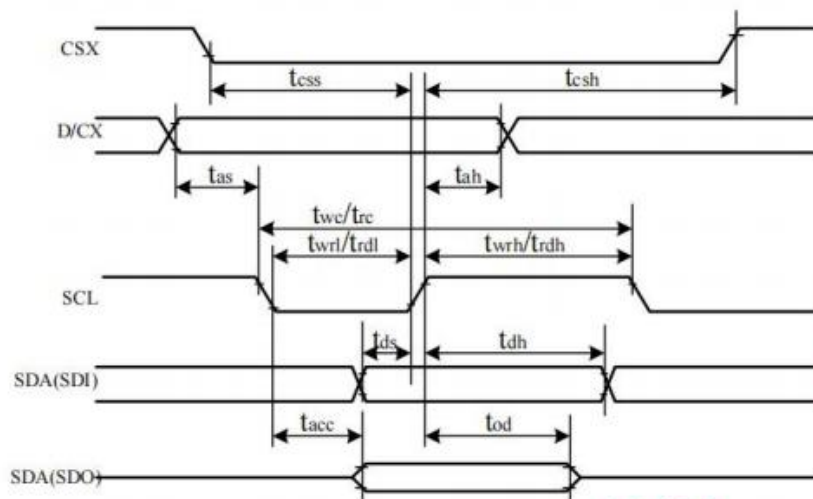
Note 2: There is not any limitation, which is not specified by User, when there is changing from one power mode to another power mode.

Table 3-5 Power on/Reset/Wake Sequence Parameters

Parameter	Description	Min	Max	Units
Tris	Rise time from 0.1VDD to 0.9VDD	-	3	ms
Tpon	Time of starting to report point after powering on	300	-	ms
Tprt	Time of being low after powering on	1	-	ms
Trsi	Time of starting to report point after resetting	300	-	ms
Trst	Reset time	5	-	ms

5.4 Timing Characteristics

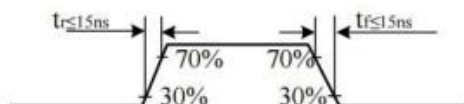
5.4.1 Timing for 4-Wire SPI Interface



Signal	Symbol	Parameter	min	max	Unit	Description
CSX	t_{css}	Chip select time (Write)	20	-	ns	
	t_{csh}	Chip select hold time (Read)	40	-	ns	
SCL	t_{we}	Serial Clock Cycle (Write)	10	-	ns	
	t_{wrh}	SCL "H" Pulse Width (Write)	5	-	ns	
	t_{wrl}	SCL "L" Pulse Width (Write)	5	-	ns	
	t_{rc}	Serial Clock Cycle (Read)	150	-	ns	
	t_{rdh}	SCL "H" Pulse Width (Read)	60	-	ns	
	t_{rdl}	SCL "L" Pulse Width (Read)	60	-	ns	
D/CX	t_{as}	D/CX setup time	10	-	ns	
	t_{ah}	D/CX hold time (Write/Read)	10	-	ns	
SDA/SDI (Input)	t_{ds}	Data setup time (Write)	5	-	ns	
	t_{dh}	Data hold time (Write)	5	-	ns	
SDA/SDO (Output)	t_{acc}	Access time (Read)	10	-	ns	

Note: $T_a = 25\text{ }^{\circ}\text{C}$, $V_{DDI}=1.65\text{V to }3.3\text{V}$, $V_{DDB}=2.5\text{V to }3.3\text{V}$, $AGND=VSS=0\text{V}$

Figure99.



5.5 Timing Diagram

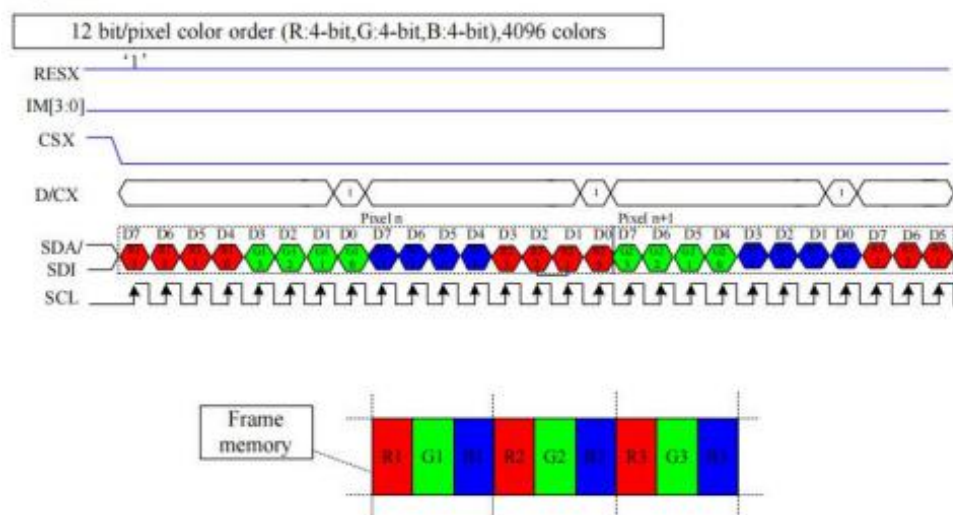
In 4-line serial interface, different display data format is available for two color depths supported by the LCM listed below.

-4k colors, RGB 4, 4, 4 -bits input.

-65k colors, RGB 5, 6, 5 -bits input.

-262k colors, RGB 6, 6, 6 -bits input.

Figure44.



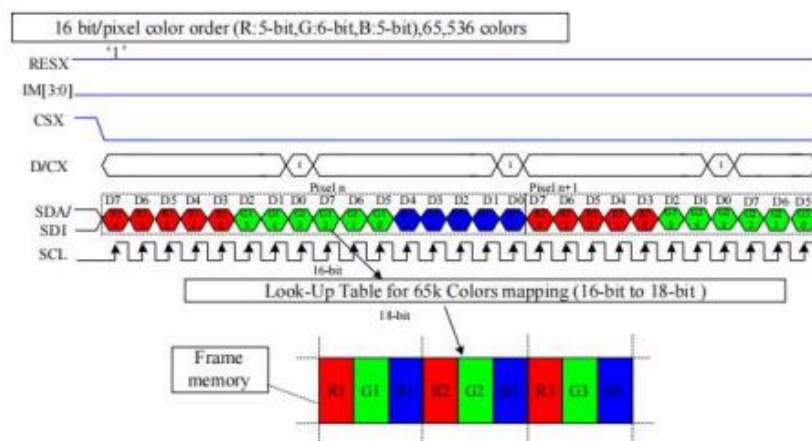
Note 1: The pixel data with 12-bit color depth information.

Note 2: The most significant bits are: Rx3, Gx3 and Bx3.

Note 3: The least significant bits are: Rx0, Gx0 and Bx0.

Note 4: '-'= Don't care -Can be set "0" or "1".

Figure45.



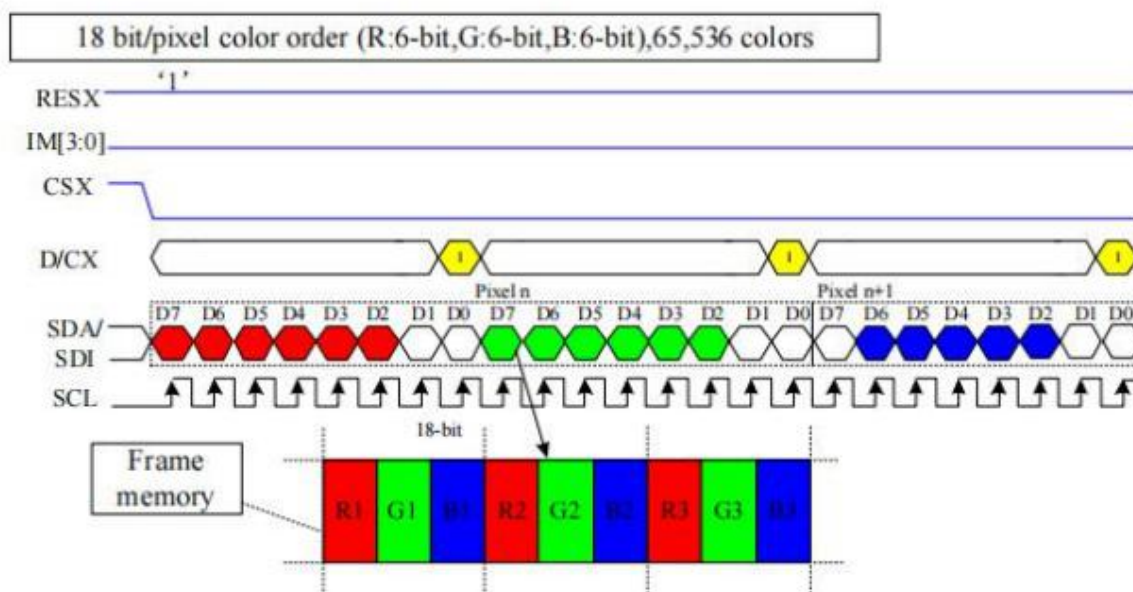
Note 1: The pixel data with 16-bit color depth information.

Note 2: The most significant bits are: Rx4, Gx5 and Bx4.

Note 3: The least significant bits are: Rx0, Gx0 and Bx0.

Note 4: '-'= Don't care -Can be set "0" or "1".

Figure46.



Note 1: The pixel data with 18-bit color depth information.

Note 2: The most significant bits are: Rx5, Gx5 and Bx5.

Note 3: The least significant bits are: Rx0, Gx0 and Bx0.

Note 4: '-'= Don't care —Can be set "0" or "1".

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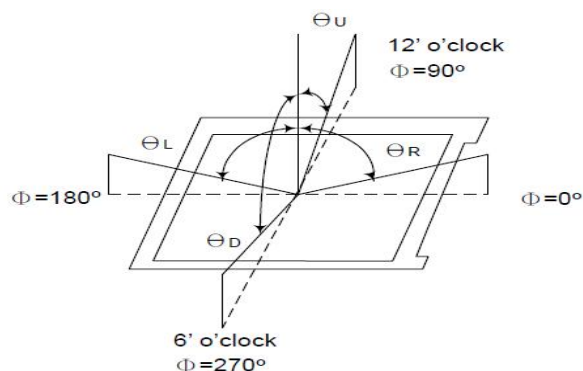
6. OPTICAL CHARACTERISTICS

Parameter 参数	Symbol 符号	Condition 条件	Min. 最小值	Typ. 典型值	Max. 最大值	Unit 单位	Remark 备注
Contrast Ratio	C/R	$\theta = 0^\circ$	900	1100	-	-	Note(4)
NTSC Ratio	S	$\theta = 0^\circ$	55	60	-	%	Note(7)
Luminance	L	$\theta = 0^\circ$	400	450	-	cd/m ²	Note(5)
Luminance uniformity	U _W	$\theta = 0^\circ$	70	80	-	%	Note(3)
Response Time	T _R + T _F	25 °C	-	30	40	ms	Note(2)
Color Coordination	W _X	$\theta = 0^\circ$ (Center) Normal viewing angle B/L On	-0.04	0.29	+0.02	NTSC (x,y)	Note(6)
	W _Y			0.32			
	R _X			0.644			
	R _Y			0.332			
	G _X			0.323			
	G _Y			0.565			
	B _X			0.134			
	B _Y			0.124			
Viewing Angle	θ_L	C/R>10	80	85	-	Degree	Note(1)
	θ_R		80	85	-		
	θ_U		80	85	-		
	θ_D		80	85	-		

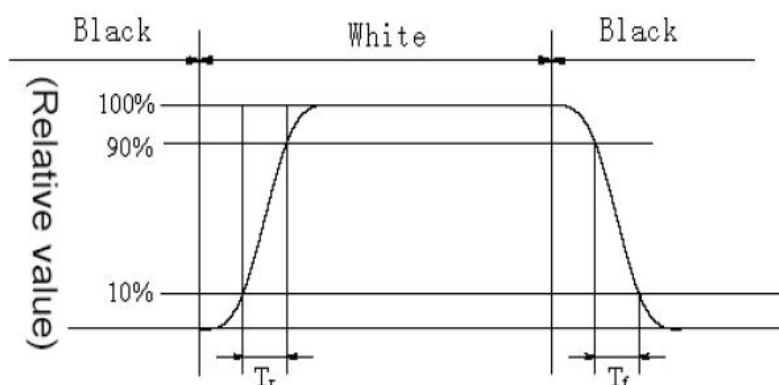
Test Conditions:

1. $V_{DD}=3.3V$, $I_F=20mA$ (Backlight current), the ambient temperature is $+25^{\circ}C$.
2. The test systems refer to Note 8.

Note1: Definition of Viewing Angle: The viewing angle range that the $CR>10$

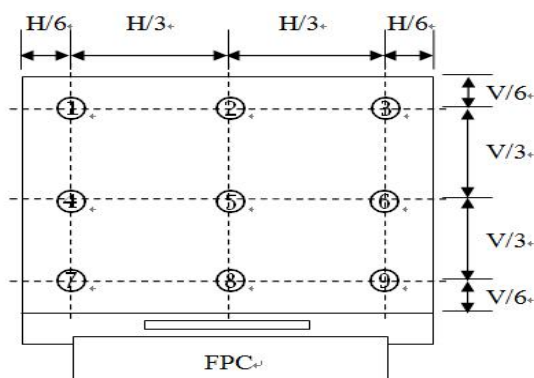


Note2: Definition of Response time: Sum of T_R and T_F



Note 3: Definition of Luminance Uniformity: Active area is divided into 9 measuring areas, every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity} = \frac{\text{Min Luminance of white among 9-points}}{\text{Max Luminance of white among 9-points}} \times 100\%$$



Note4: Definition of Contrast Ratio (CR): measured at the center point of panel

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

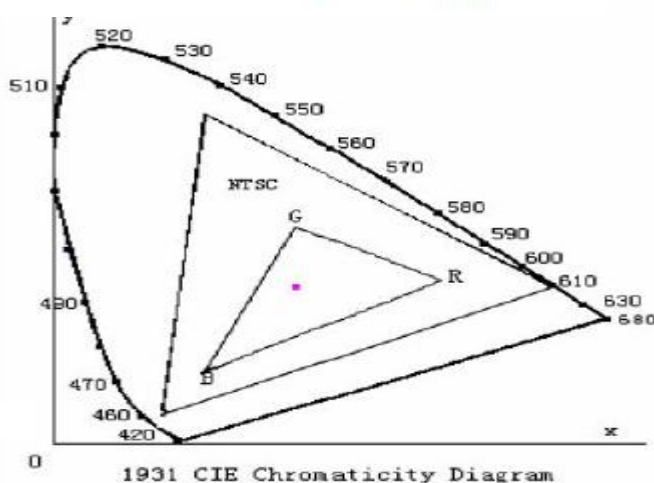
Note 5: Definition of Luminance: Center Luminance of white is defined as luminance values of 1 point average across the LCD surface.

Note 6: Definition of Color Chromaticity (CIE 1931)

Color coordinates of white & red, green, blue measured at center point of LCD.

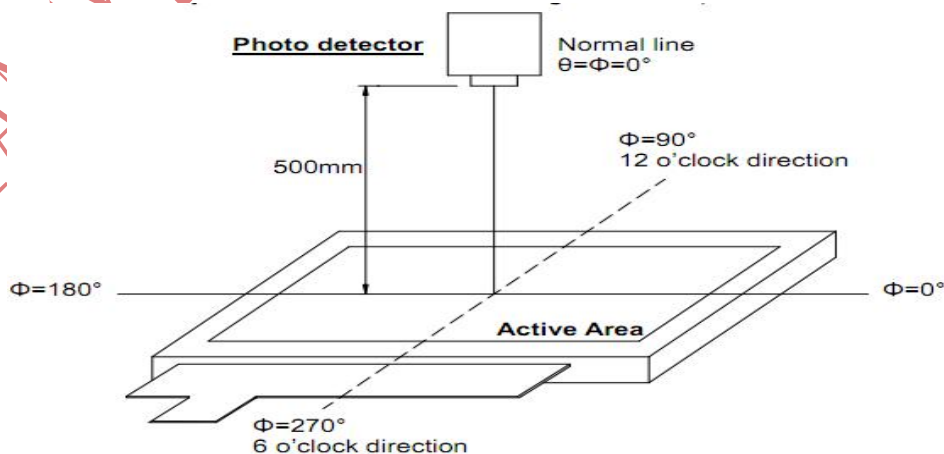
Note 7: Definition of NTSC ratio:

$$\text{NTSC ratio} = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}}$$



Note 8: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. (Response time is measured by Photo detector TOPCON BM-7, Field of view: 1°/Height: 500mm.)



7. RELIABILITY

Item 项目	Test Condition 测试条件	Remark 备注
High Temperature Storage	Ta =+80°C / 96Hours	Note1,2,3
Low Temperature Storage	Ta =-30°C / 96Hours	Note1,2,3
High Temperature Operating	Ta =+70°C / 96Hours	Note1,2,3
Low Temperature Operating	Ta =-20°C / 96Hours	Note1,2,3
Temperature Cycle storage Test	-30°C/30min Δ +80°C /30min for 30cycles, Transfer time less than 5min	Note2,3
Thermal humidity storage Test	60°C x 90%RH / 96Hours	Note2,3
Package Vibration Test	Frequency: 10Hz~55Hz, Amplitude: 1.5mm, 1 hrs for each direction of X, Y, Z	Note2
ESD	C=150PF, R=330 Ohm Air: $\pm$ 8kv, 5times(Center) Contact: $\pm$ 4kv, 5times(Center)	Note4

Inspection after Test:

Note1: Ta is the ambient temperature of samples.

Note 2: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but doesn't guarantee all the cosmetic specification.

Note 3: Before cosmetic and function tests, the product must have enough recovery time, at least 2 hours at room temperature.

Note 4: In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

8. PACKAGE DRAWING

