

LCD MODULE
SPECIFICATION

Model:	UE015QV-RB15-L005-B
Version:	V1.0
Date:	20181011

Preliminary Specification 样品规格书

Final Specification 量产规格书

Customer Confirmation 客户确认

Approved by	Notes

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VIEWE Confirmation 优奕确认

Prepared by	Reviewed by	Approved by

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1. GENERAL INFORMATION

1.1 Features

- 1) Pixel Arrangement: RGB Vertical Stripe
- 2) Interface Mode: SPI_4
- 3) Driver IC: ST7789V
- 4) Operation Temperature: -20~70°C
- 5) Storage Temperature: -30~80°C
- 6) Backlight Type: White LED
- 7) Display mode: Normally Black
- 8) Pixel Density: 220 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	1.54	Inch	Diagonal
Resolution	240(W)*3(RGB)*240(H)	Dots	
Interface	SPI	-	4lane
Module Power Consumption	0.28	Watt	Typ.
Active Area	27.72(W)*27.72(H)	mm	
Pixel pitch (W*H)	0.1155(W)*0.1155(H)	mm	
Module Size (W*H*D)	30.52(W)*33.72(H)*1.37(D)	mm	Tolerance: ±0.1
Luminance	320	cd/m ²	Typ.
Viewing Direction	All	O'clock	-
Display Color	262K	Colors	8bits



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
Power supply2 voltage	IOVCC	-0.3	4.6	V	Note1
LED forward current	I _F	-0.001	30	mA	For each led,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,GND=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 .

3. MECHANICAL DRAWING

<p>基本规格:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>DISPLAY TYPE:</td><td>L.54" IPS TFT</td></tr> <tr><td>NORMALLY BLACK</td><td>TRANSMISSIVE</td></tr> <tr><td>RESOLUTION:</td><td>240(GRD)*240</td></tr> <tr><td>Driver IC:</td><td>ST7789V(LCD)/G15663(GP)</td></tr> <tr><td>Viewing Angle (D/L/R):</td><td>80/80/80 Typ</td></tr> <tr><td>LCM# BRIGHTNESS:</td><td>200 MIN 250 TYP cd/m2</td></tr> <tr><td>Chromaticity (W TYP):</td><td>900 TYP</td></tr> <tr><td>Contrast:</td><td>50X TYP</td></tr> <tr><td>MISC:</td><td>50% MIN</td></tr> <tr><td>Unit Formity:</td><td>80% MIN</td></tr> <tr><td>TC:</td><td></td></tr> <tr><td>GAMMA:</td><td></td></tr> <tr><td>CROSS-TALK:</td><td></td></tr> <tr><td>BL/CK LIGHT:</td><td>Spec. 提供并检测(20mA/LED)</td></tr> <tr><td>Interface:</td><td></td></tr> <tr><td>OPERATING TEMP.:</td><td>-20° C ~ 70° C</td></tr> <tr><td>STORAGE TEMP.:</td><td>-30° C ~ 80° C</td></tr> <tr><td>电压:</td><td>I(VDD)=1.8V(TYP) V(D)=2.8V(TYP)</td></tr> <tr><td>平面度:</td><td>0.3500 MAX</td></tr> <tr><td>寄存器地址:</td><td></td></tr> </table>	DISPLAY TYPE:	L.54" IPS TFT	NORMALLY BLACK	TRANSMISSIVE	RESOLUTION:	240(GRD)*240	Driver IC:	ST7789V(LCD)/G15663(GP)	Viewing Angle (D/L/R):	80/80/80 Typ	LCM# BRIGHTNESS:	200 MIN 250 TYP cd/m2	Chromaticity (W TYP):	900 TYP	Contrast:	50X TYP	MISC:	50% MIN	Unit Formity:	80% MIN	TC:		GAMMA:		CROSS-TALK:		BL/CK LIGHT:	Spec. 提供并检测(20mA/LED)	Interface:		OPERATING TEMP.:	-20° C ~ 70° C	STORAGE TEMP.:	-30° C ~ 80° C	电压:	I(VDD)=1.8V(TYP) V(D)=2.8V(TYP)	平面度:	0.3500 MAX	寄存器地址:		<p>产品规格</p> <p>BACKLIGHT CIRCUIT DIAGRAM 20mA/LED (3LED)</p> <p>LED VF: 3.2V(TYP) If: 60mA</p> <p>背光电路图 (Circuit Diagram)</p> <p>LED A — LED K</p> <p>NOTE: 1. VIEWING DIRECTION: FULL VIEW 2. 本产品符合RoHS要求 3. GENERAL TOLERANCE: ±0.2 () *reference dimension *为重大尺寸 4. 客户终端使用连接器型号:PH06-15S-0.35MM 5. 产品要求SMD可以硬件无供电 6. 建议适合的开孔尺寸比LCD AA左右宽度尺寸单边大0.3. 7. ESD(静电):接触/-4KV, 空气/+8KV 8. 封装: 单点/子号 9. 盖板材料: 钢化玻璃 (表面硬度≥8H)</p>																					
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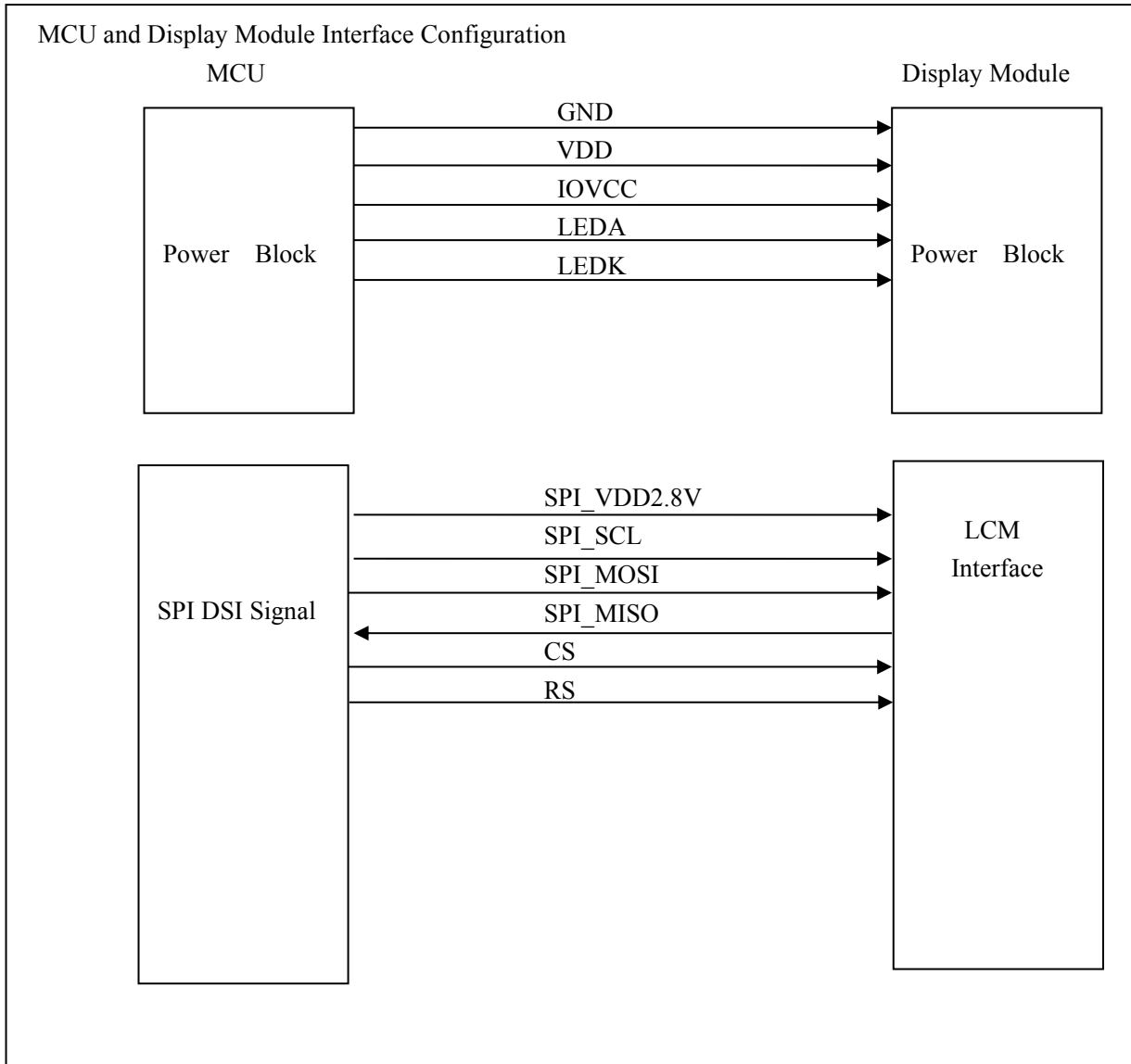
4. I/O CONNECTION & BLOCK DIAGRAM

4.1 I/O Connection

Pin No. 序号	Symbol 符号	I/O	Description 描述
1	LED_K	P	Power for Backlight Cathode
2	GND	P	Power Ground
3	LED_A	P	Power for Backlight Anode
4	CS	I	Chip selection pin
5	SPI_MISO	O	SPI interface output pin
6	RS	I	Display data/command selection pin in 4-line serial interface. Second Data lane in 2 data lane serial interface.
7	RESET	I	Global reset for LCM, active is low
8	GND	P	Power Ground
9	TE	O	Tearing effect signal is used to synchronize MCU to frame memory writing.
10	SPI_SCL	I	This pin is used to be serial interface clock.
11	LCM_ID	O	ID Select.
12	SPI_MOSI	I	SPI interface input pin
13	IOVCC	P	Power supply to the I/O(1.8V).
14	GND	P	Power Ground
15	VDD	P	Power supply for analog circuit(2.8V).

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	VDD	2.5	2.8	3.3	V	-
Power Supply2 Voltage	IOVCC	1.65	1.8	3.3	V	-
Power Supply Current	I _{VDD}	-	30	-	mA	Note1
Logic Input High Voltage	V _{IH}	0.7VDD	-	VDD	V	-
Logic Input Low Voltage	V _{IL}	0	-	0.3VDD	V	-
Panel Power Consumption	P _{VDD}	-	0.084	-	Watt	Note1
Module Power Consumption	P _{LCM}	-	0.28	-	Watt	Note1,2

(Ta=+25°C,GND=0V)

Note1: Measurement Conditions (Video Mode): Full Screen Red Pattern, VDD=2.8V, 60Hz Refresh.

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

5.2 Back Light Driving Section

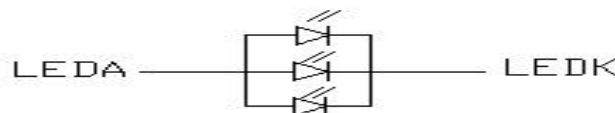
Item 项目	Symbol 符号	Min. 最小值	Typ. 典型值	Max. 最大值	Unit 单位	Remark 备注
Forward Voltage	V _F	-	3.2	-	V	Note1
Forward Current	I _F	-	60	-	mA	Note1
Backlight Power consumption	P _{B/L}	-	0.192	-	Watt	Note1
LED life time	-	30000	-	-	Hours	Note2
LED Quantity	-	-	3	-	PCS	

(Ta=+25°C,GND=0V)

Note1: The LED driving condition is defined for each LED module (1 LED Serial, 3 LED Parallel).

For each LED : I_F=20mA, V_F=9.6V(Typ.), Ta=25°C。

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 20mA.



BACKLIGHT CIRCUIT DIAGRAM 20mA/LED (3LED)

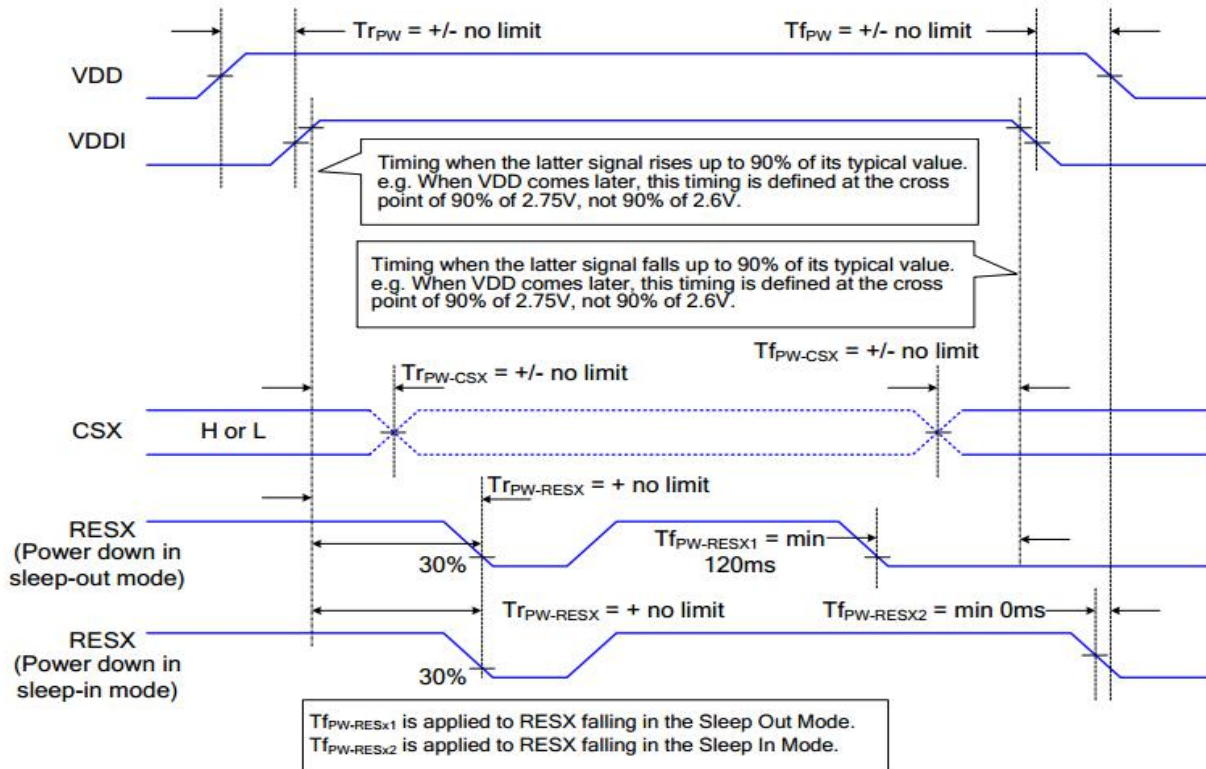
LED V_f: 3.2V (TYP)

I_f: 60mA

背光电路图

5.3 Power On/Off Sequence

5.3.1 Power On Sequence



5.3.2 Power Off Sequence

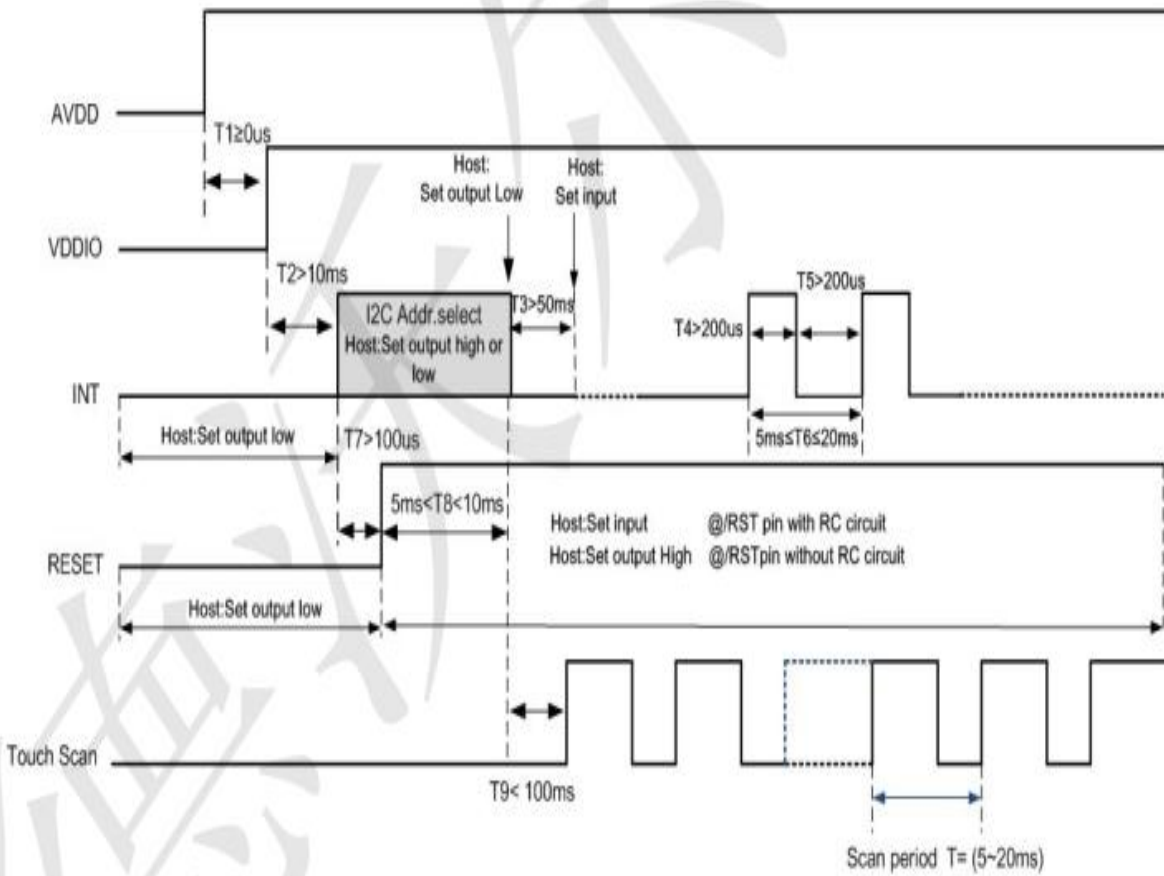
The uncontrolled power-off means a situation which removed a battery without the controlled power off sequence. It will neither damage the module or the host interface.

If uncontrolled power-off happened, the display will go blank and there will not any visible effect on the display (blank display) and remains blank until "Power On Sequence" powers it up.

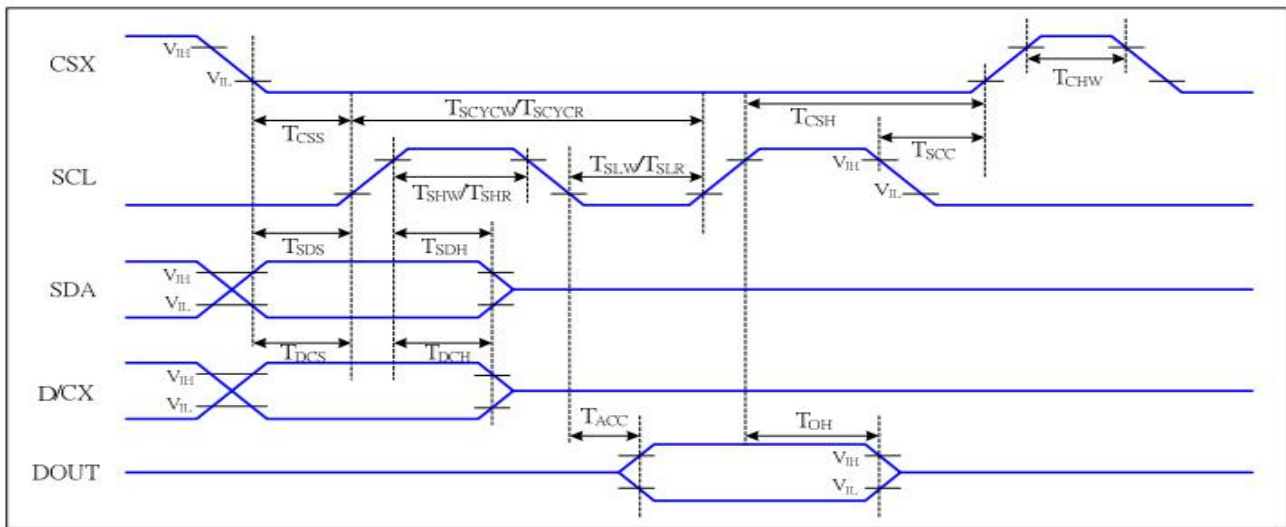


5.4 Timing Characteristics

上电时序图:



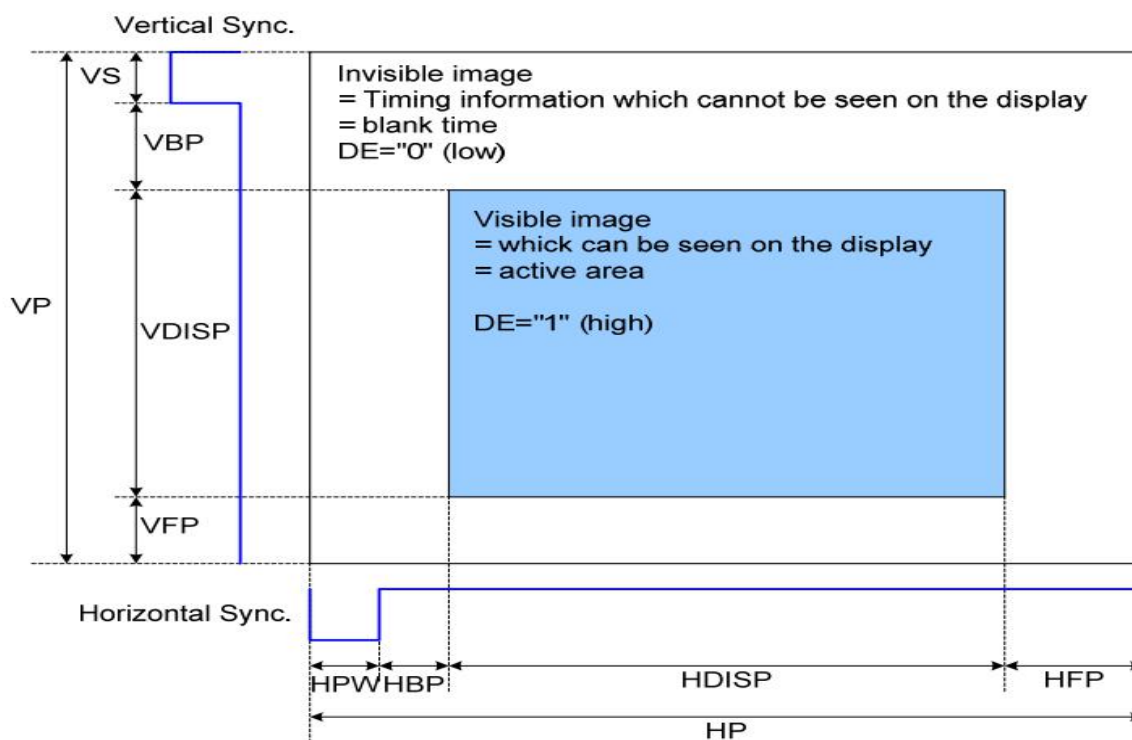
5.4.1 SPI AC Characteristics



Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum $CL=30pF$
	T_{OH}	Output disable time	15	50	ns	For minimum $CL=8pF$

5.5 Timing Diagram

5.5.1 Horizontal + Vertical Timings



5.5.3 Timing Parameters

Parameter	Symbol	Value			Unit
		Min.	Typ.	MAX.	
Bit rate per lane	BR _{PHY}	-	-	1000	Mbps
Active pixel per line	HACT	-	240	-	Pixels
Horizontal back porch	t _{HBP}	-	24	-	DCLK
Horizontal sync active	t _{HS}	-	10	-	DCLK
Horizontal front porch	t _{HFP}	-	32	-	DCLK
Active pixel per frame	VACT	-	240	-	H
Vertical back porch	t _{VBP}	-	16	-	H
Vertical sync active	t _{VSA}	-	10	-	H
Vertical front porch	t _{VFP}	-	12	-	H

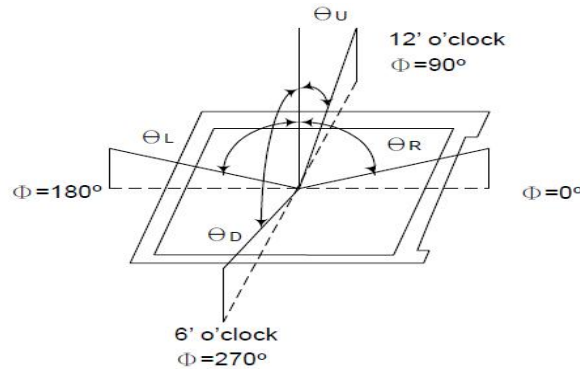
6. OPTICAL CHARACTERISTICS

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	-	-	Note(4)
NTSC Ratio	S	$\theta = 0^\circ$	-	50	-	%	Note(7)
Luminance	L	$\theta = 0^\circ$	-	250	-	cd/m ²	Note(5)
Luminance uniformity	U _W	$\theta = 0^\circ$	80	85	-	%	Note(3)
Response Time	T _R + T _F	25 °C	-	35	50	ms	Note(2)
Color Coordination	W _X	$\theta = 0^\circ$ (Center) Normal viewing angle B/L On	-0.03	0.295	+0.03	NTSC (x,y)	Note(6)
	W _Y			0.325			
	R _X			0.626			
	R _Y			0.310			
	G _X			0.296			
	G _Y			0.518			
	B _X			0.144			
	B _Y			0.139			
Viewing Angle	θ_L	C/R>10	70	80	-	Degree	Note(1)
	θ_R		70	80	-		
	θ_U		70	80	-		
	θ_D		70	80	-		

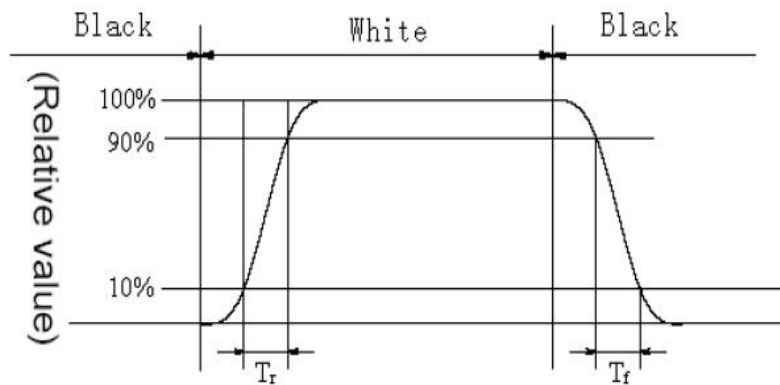
Test Conditions:

- VDD=2.8V, I_F=40mA (Backlight current), the ambient temperature is +25°C.
- The test systems refer to Note 8.

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

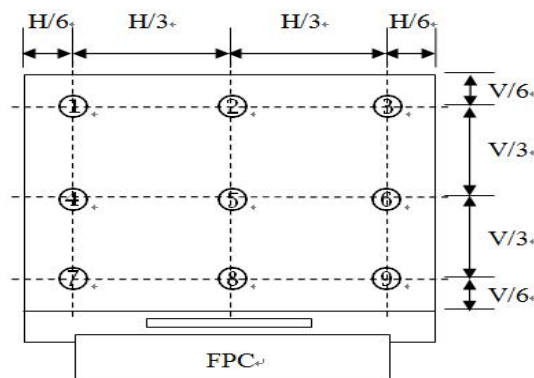


Note2: Definition of Response time: Sum of T_R and T_F



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

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

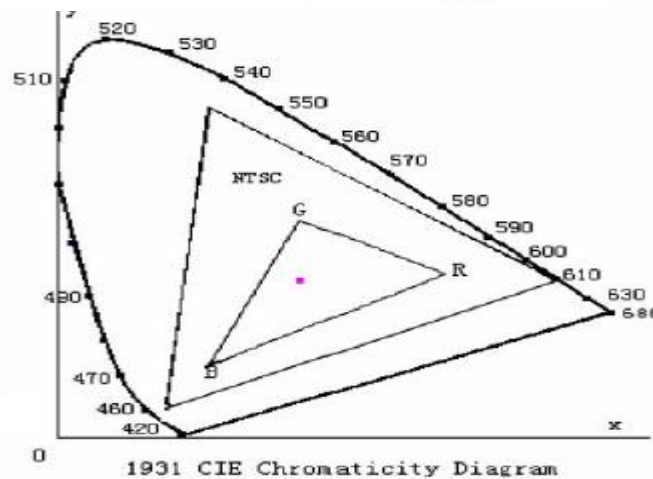
Note 5: Definition of Luminance: Center Luminance of white is defined as luminance values of 1point average across the LCD surface.

Note 6: Definition of Color Chromaticity (CIE 1931)

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

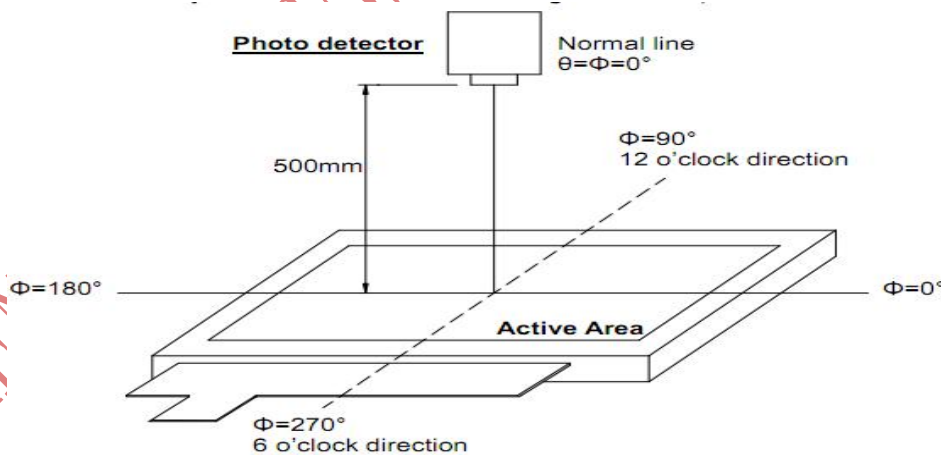
Note 7: Definition of NTSC ratio:

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



Note 8: Definition of 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 ↔+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
Packing shock test	Drop to the ground from 60cm height, 1 corner, 3 edges, 6 surfaces.	Note2

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.

8. PACKAGE DRAWING

