PRODUCT SPECIFICATION

TFT-LCD MODULE

Model No：FRD395H50005-A-CTK

For Customer's Acceptance	
Approved by	**Comment**

	Signature	Date
Prepared by	袁宝龙	**2024.05.25**
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Contents

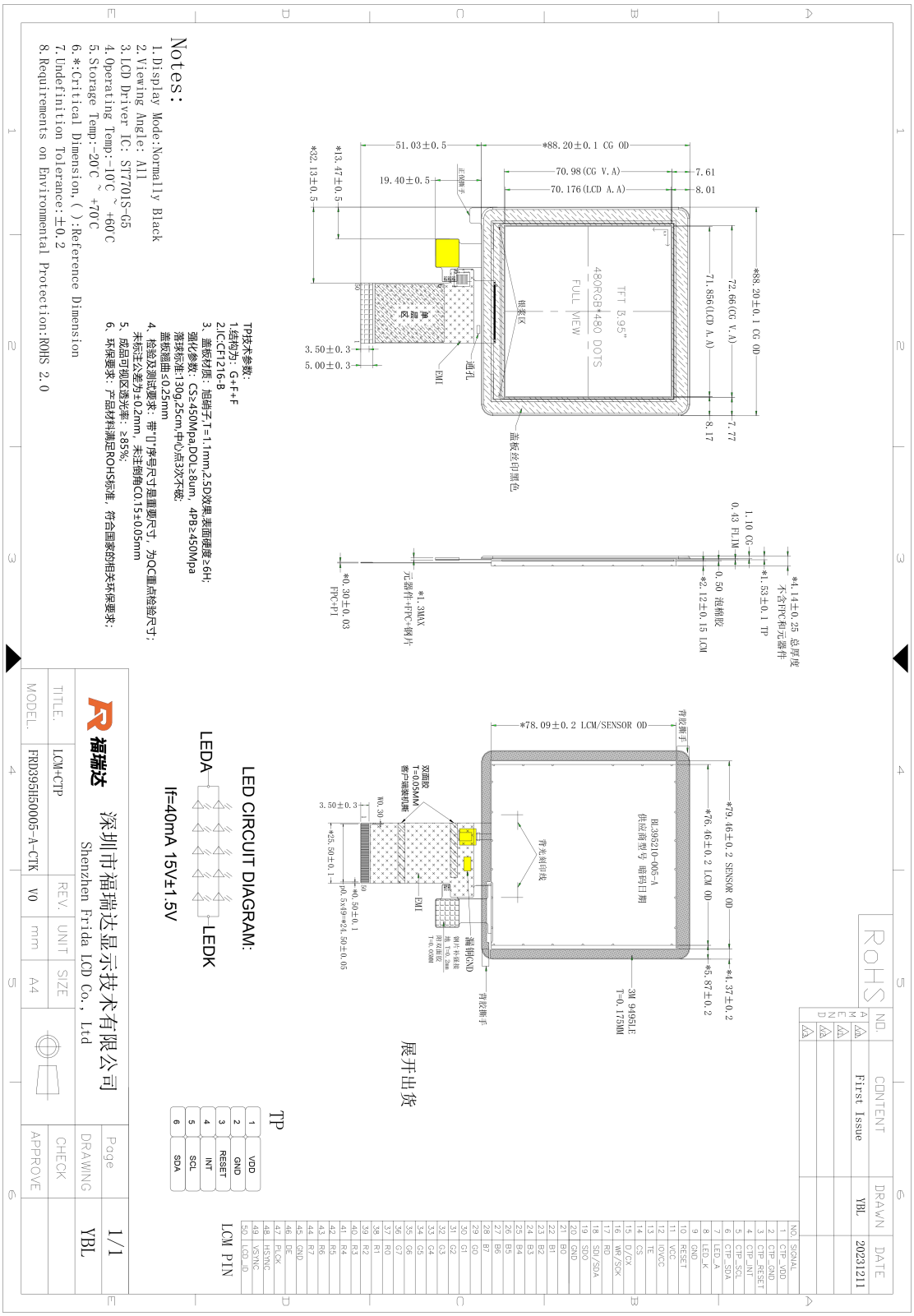
1. Document Revision History :

DOCUMENT REVISION	DATE	DESCRIPTION	PREPARED BY
A	2024-05-25	First Release.	

2. General Description

No	Item	Specification	Remark
1	Screen Size	3.95 inch	
2	Display Mode	Normally Black	
3	Resolution	480 × RGB × 480	
4	Active Area	71.856*70.176	mm
5	Outline Dimension	88.2*88.2*4.14	mm
6	Viewing Direction	All	
7	Driver IC	ST7701S-G5	
8	Interface	SPI+RGB	
9	Back Light	White Led*10	
10	Touch Panel	CTP	

3. Outline Dimension



4. Interface Specification

Pin No	Symbol	Description	Note
1	CTP_VDD	Power Supply For CTP	
2	CTP_GND	Ground.	
3	CTP_RESET	Reset Signal input pin.	
4	CTP_INT	CTP interrupt request	
5	CTP_SCL	Serial clock signal pin.	
6	CTP_SDA	Serial data input/output pin.	
7	LED_A	Power Supply For LED Backlight Anode Input.	
8	LED_K	Power Supply For LED Backlight Cathode Input.	
9	GND	Ground.	
10	RESET	Reset Signal input pin.	
11	VCC	Power Supply For LCD.	
12	IOVCC	Power Supply For I/O.	
13	TE	Frame head pulse for tearing effect.	
14	CS	Chip selection signal.	
15	D/CX	No Connection.	
16	WR/SCK	Serial clock signal.	
17	RD	No Connection.	
18	SDI/SDA	Serial data input/output pin.	
19	SDO	Serial data output pin.	
20	GND	Ground.	
21-28	B0-B7	Blue data (B0-LSB;B7-MSB)	
29-36	G0-G7	Green data (G0-LSB; G7-MSB)	
37-44	R0-R7	Red data (R0-LSB;R7-MSB)	
45	GND	Ground.	

46	DE	Data enable signal for RGB interface operation.	
47	PLCK	Dot clock signal for RGB interface operation.	
48	HSYNC	Line synchronous signal for RGB interface operation.	
49	VSYNC	Frame synchronous signal for RGB interface operation.	
50	LCD_ID	No Connection.	

TP

Pin No	Symbol	Description	Note
1	VDD	Power Supply For CTP	
2	GND	Ground.	
3	RESET	Reset Signal input pin.	
4	INT	CTP interrupt request	
5	SCL	Serial clock signal pin.	
6	SDA	Serial data input/output pin.	

5.Absolute Maximum Ratings

Electrical Maximum Ratings – for IC Only

Parameter	Symbol	Min.	Max.	Unit	Note
Power supply voltage (VDD)	VDD	-0.3	+4.6	V	1&2

Note:

1.VDD, GND must be maintained.

2.The modules may be destroyed if they are used beyond the absolute maximum ratings.

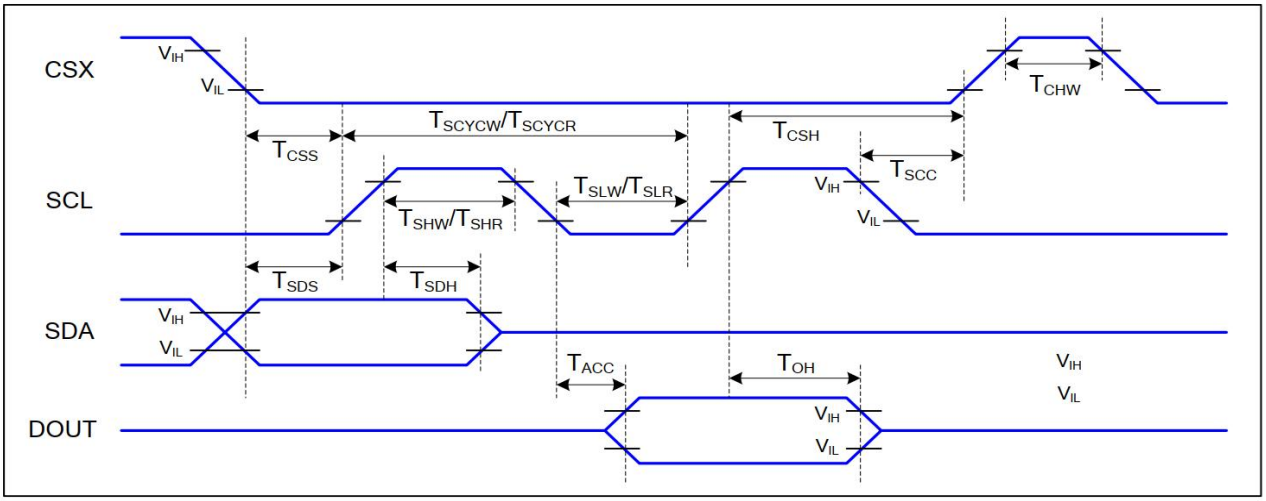
6. Electrical Specifications

At Ta = 25 ℃, VDD = 2.5V to 3.6V, GND=0V.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (analog)	VDD-GND		2.5	2.8	3.6	V
Supply voltage of white LED backlight	VLED	Forward current =40mA Number of LED = 10	13.5	15.0	16.5	V

7. Timing Characteristics

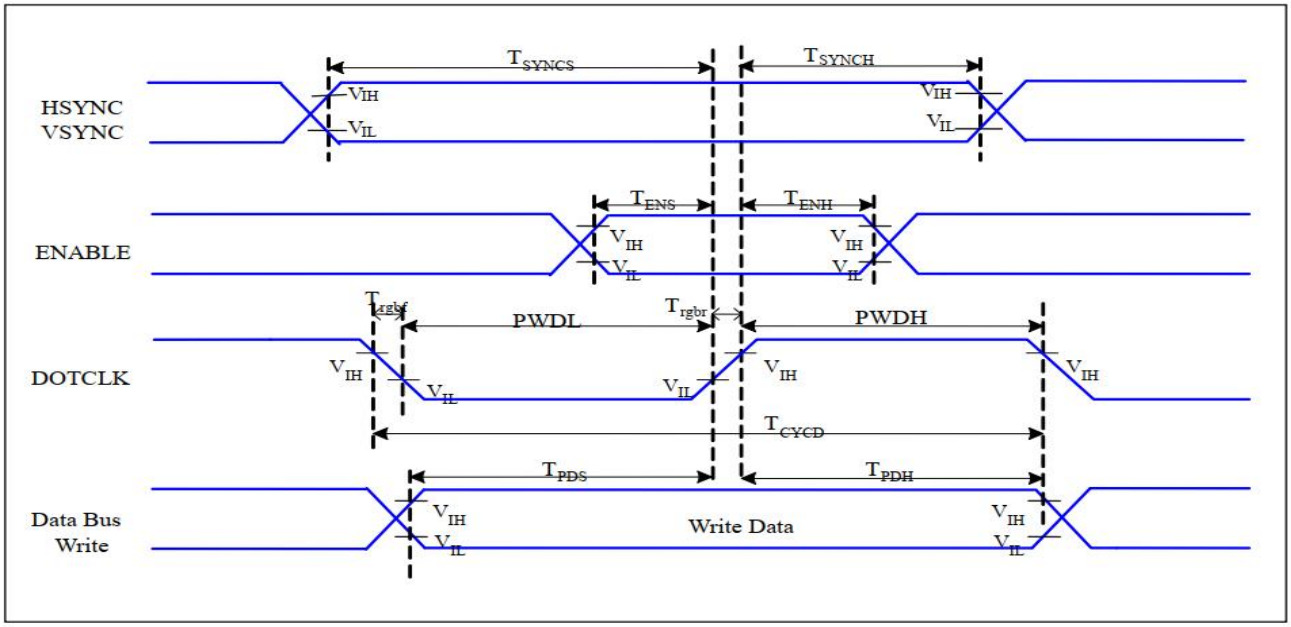
Serial Interface Characteristics (3-line serial):



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)	60		ns	
	T_{CHW}	Chip select “H” pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	
	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	
	T_{SHR}	SCL “H” pulse width (Read)	60		ns	
	T_{SLR}	SCL “L” pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

RGB Interface Characteristics :



Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T_{SYNCS}	VSYNC, HSYNC Setup Time	5	-	ns	
ENABLE	T_{ENS}	Enable Setup Time	5	-	ns	
	T_{ENH}	Enable Hold Time	5	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	15	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	15	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	33	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	15	ns	
DB	T_{PDS}	PD Data Setup Time	5	-	ns	
	T_{PDH}	PD Data Hold Time	5	-	ns	

Please refer to the following table for the setting limitation of RGB interface signals.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Horizontal Sync. Width	hpw	2	-	255	Clock
Horizontal Sync. Back Porch	hbp	2	--	255	Clock
Horizontal Sync. Front Porch	hfp	2	--	-	Clock
Vertical Sync. Width	vs	2	--	254	Line
Vertical Sync. Back Porch	vbp	2	--	254	Line
Vertical Sync. Front Porch	vfp	2	--	--	Line

Note:

1. *Typical value are related to the setting frame rate is 60Hz..*

8. Power Supply Configuration

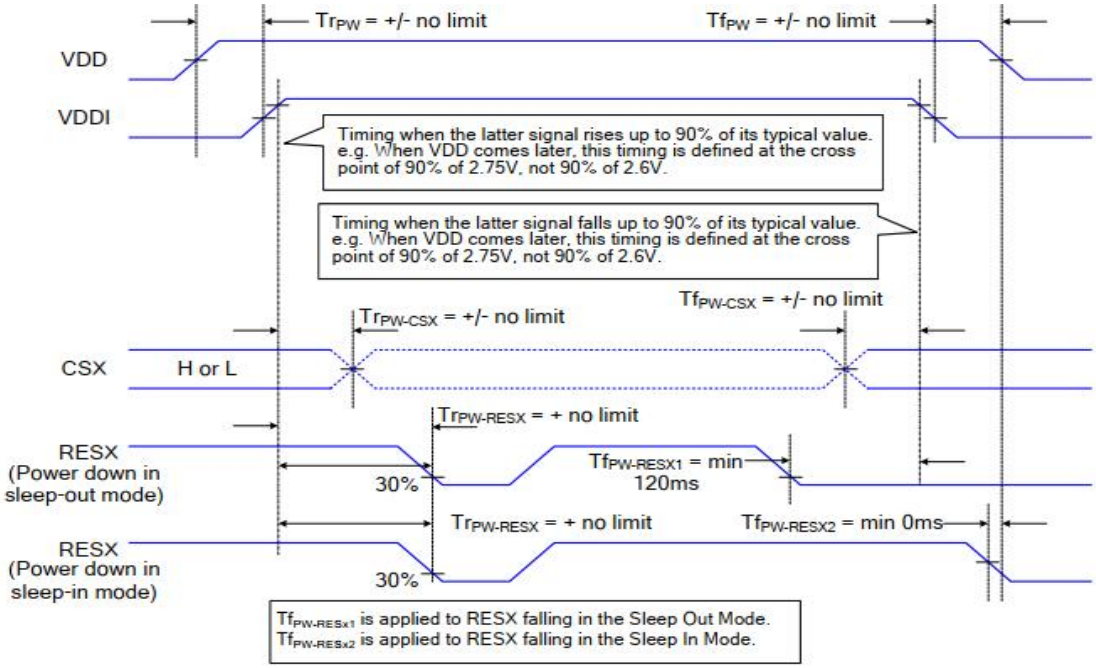
VDDI and VDDA can be applied or powered down in any order. During the Power Off sequence, if the LCD is in the Sleep Out mode, VDDA and VDDI must be powered down with minimum 120msec. If the LCD is in the Sleep In mode, VDDA and VDDI can be powered down with minimum 0msec after the RESX is released.

CSX can be applied at any timing or can be permanently grounded. RESX has high priority over CSX.

Notes:

1. There will be no damage to the ST7701S if the power sequences are not met.
2. There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.
3. There will be no abnormal visible effects on the display between the end of Power On Sequence and before receiving the Sleep Out command, and also between receiving the Sleep In command and the Power Off Sequence.
4. If the RESX line is not steadily held by the host during the Power On Sequence as defined in Sections 9.1 and 9.2, then it will be necessary to apply the Hardware Reset (RESX) after the completion of the Host Power On Sequence to ensure correct operations. Otherwise, all the functions are not guaranteed.

The power on/off sequence is illustrated below



Uncontrolled Power Off

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.

9.Optical Specification

Item 项目	Symbol 符号	Condition 条件	Min 最小值	Typ 典型值	Max 最大值	Unit 单位	Note 备注
Response time 响应时间	Tr+Tf	Θ=0° Ø=0° Ta=25°C	-	25	35	ms	1
Contrast ratio 对比度	Cr		640	800	-	-	2
Color gamut 饱和度	S(%)		55	60	-	%	-
Luminance uniformity 均匀度	δWHITE		80	-	-	%	3
Viewing angle range 视角范围	Θx+	CR≧10 Ta=25°C	-	80	-	deg	4
	Θx-		-	80	-	deg	
	Θy+		-	80	-	deg	
	Θy-		-	80	-	deg	
LCM Luminance LCM 亮度	Lv	Θ=0° Ø=0° Ta=25°C	-	350	-	Cd/m^2	5

Note1.Response time is the time required for the display to transition from White to black(Rise Time,Tr)and from black to white(Decay Time,Tf).For additional information see FIG1...

Note2.contrast Ratio(CR) is defined mathematically by the following formula ,For more information see FIG2.

Contrast Ratio(CR)=Average Surface Luminance with all white pixels/ Average Surface Luminance with all black pixels

Note3.The uniformity in surface luminance(WHITE) is determined by measuring luminance at eath test position,and then dividing the maximum luminance of all white pixels by minimum luminance of all white pixels,For more information seeFIG2.

WHITE=Minimum Surface Luminance with all white pixels(P1,P2,.....)/Maximum Surface Luminance with all white pixels(P1,P2,.....)

Note4.Viewing angle is the angel at which contrast ratio is greater than a specific value.For TET module,the specific value of contrast ratio is 10.For monochrome and color stn module,the specific value of contrast ratio is2.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 FIG3

Note5. Surface luminance is the LCD surface luminance with all white pixels,For more information see FIG2.

LV=Average Surface Luminance with all white pixels(P1,P2,.....)

FIG1. The definition of Response time

响应时间定义

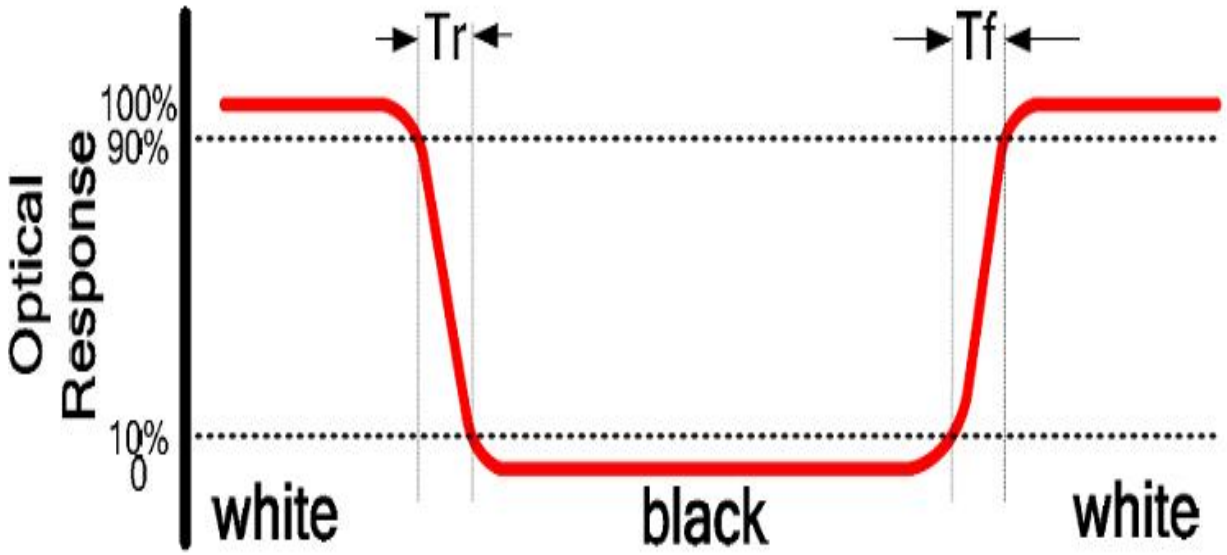


FIG2. Measuring method for Contrast ratio,surface luminance,Luminance uniformity,CIE(X,Y)chromaticity.

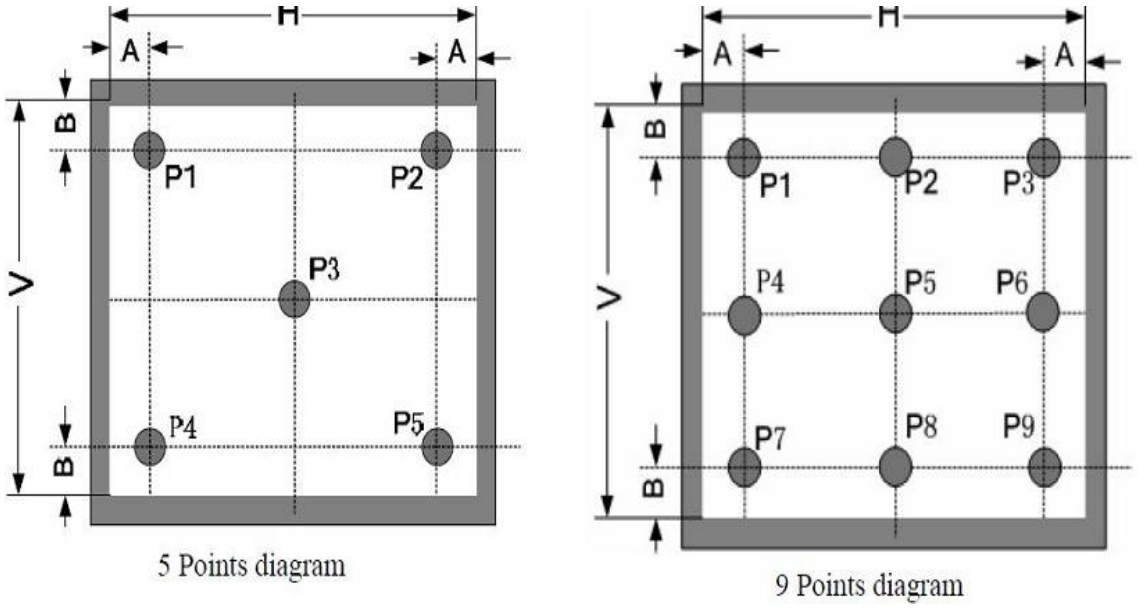
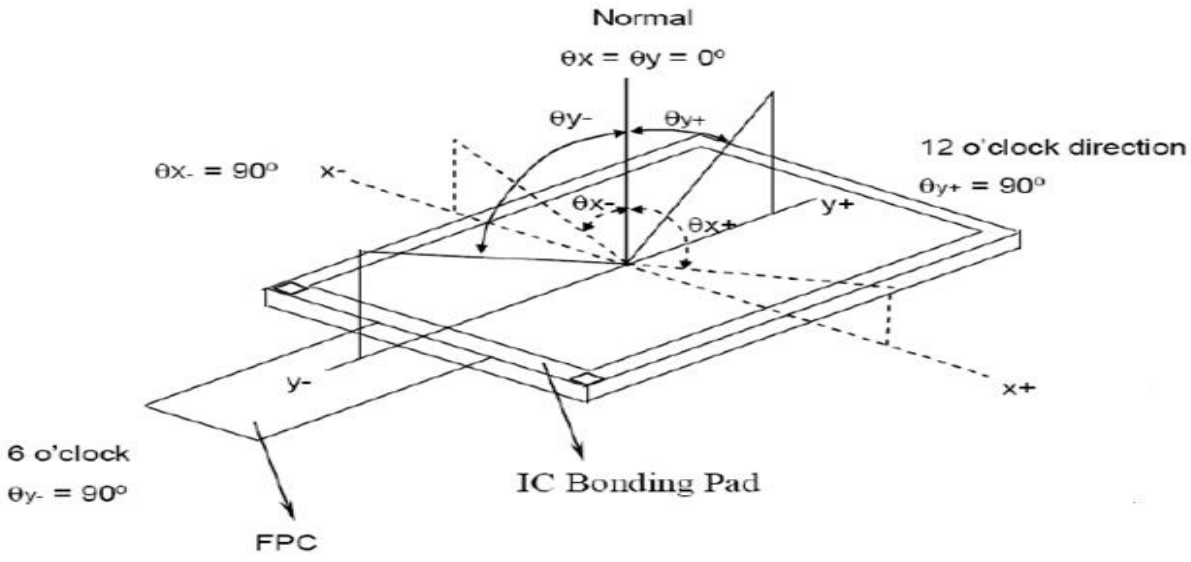


FIG3 The definition of viewing angle 视角定义



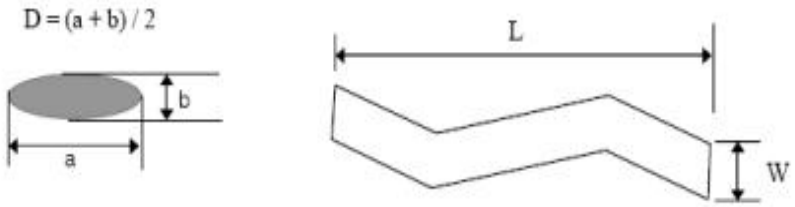
10. Inspection Specifications

10.1 **Appearance inspection**

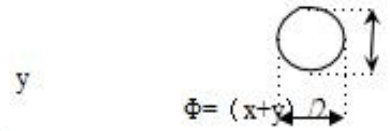
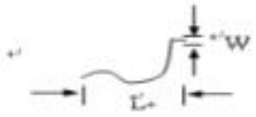
Item	Acceptable standards for defects	Defect level
Broken	Not allowed	critical defects
Cracks	Not allowed	critical defects
Insufficient UV glue entering	Not allowed	critical defects
Liquid crystal seal leakage	Not allowed	critical defects
Liquid crystal bubbles	Not allowed	critical defects
Surface scratch(mm)	W ≤0.02,ignored	minor defects
	0.02< W ≤0.03 L ≤ 2, N ≤ 2	
	0.03< W ≤0.05 L ≤ 1, N ≤ 1	
	0.05< W Not allowed	
Black/white spot(mm)	D≤ 0.1, ignored; 0.1<D≤ 0.15, N ≤ 4	minor defects
	0.15<D≤ 0.2, N ≤ 2; 0.2< D,Not allowed	
The seal pollution	Not allowed	minor defects
Liquid crystal residues	Not allowed	minor defects
Surface stains	Stains that cannot be cleaned or erased are not allowed	minor defects
size	Refer to the product specification corresponding to each product, overall size(including length, Width, thickness) or partial size exceeding the drawing size is not allowed	major defects

Remarks：1)Surface scratches within 1.5mm of the glass edge are ignored；

2) D = diameter, L = length, W = width, N = qty；



10.2 Functional testing

<table>
<tr><th>Items</th><th>Judgement standard</th><th>Defect types</th></tr>
<tr><td rowspan="3">Display state</td><td>No display, few pictures, few or more lines, wrong viewing angle, flicker, picture abnormality, etc. are allowed.</td><td>Maj</td></tr>
<tr><td>The color effect is judged by reference to the signature or by the limited template.</td><td>Min</td></tr>
<tr><td>MURA class or phenomena that can not be described in words, use ND5% or both sides make limit template to determine.</td><td>Min</td></tr>
<tr><td>Display point
(bright/dark) defect</td><td>Definition of Point Defect：
 
<table>
<tr><th rowspan="2">Size(mm)</th><th colspan="2">Acceptable number</th></tr>
<tr><th>A.A</th><th>V.A</th></tr>
<tr><td>Φ≤0.1</td><td>Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1＜Φ≤0.15</td><td>2（Space ≥5）</td></tr>
<tr><td>0.15＜Φ≤0.2</td><td>1</td></tr>
<tr><td>0.2＜Φ</td><td>Not allow</td></tr>
</table></td><td>Min</td></tr>
<tr><td>Display black/white lines</td><td>Definition of linear defect：
 
<table>
<tr><th colspan="2">Size (mm)</th><th colspan="2">Acceptable number</th></tr>
<tr><th>W</th><th>L</th><th>A.A</th><th>V.A</th></tr>
<tr><td>W≤0.03</td><td>Ignore</td><td>Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.03＜W≤0.05</td><td>L≤2.0</td><td>3</td></tr>
<tr><td>W＞0.05</td><td>-</td><td>Not allow</td></tr>
</table></td><td>Min</td></tr>
</table>

11.Reliability Test Items

Item	Test Condition	Criterion
High Temperature Storage	70 ℃, 48 hrs	Note1,Note2
Low Temperature Storage	-20 ℃, 48 hrs	
High Temp. & High Humidity Storage	40 ℃, 80％ RH, 48hrs	
Thermal Shock (Static)	-10℃, 30 min /60℃, 30 min, 20 cycles	
High Temperature Operation	60 ℃, 48 hrs	
Low temperature Operation	-10 ℃, 48 hrs	

Note1:Evaluation should be tested after storage at room temperature for two hours.
Note2:
Pass: Normal display image no line defect.
Fail: No display image, or line defects.
Partial transformation of the module parts should be ignored.12.Precautions

Please pay attentions to the followings as using the LCD module.

Handling

(a) Do not apply strong mechanical stress like drop, shock or any force to LCD module. It may cause improper operation, even damage.

(b) Because the polarizer is very fragile and easy to be damaged, do not hit, press or rub the display surface with hard materials.

(c) Do not put heavy or hard material on the display surface, and do not stack LCD modules.

(d) If the display surface is dirty, please wipe the surface softly with cotton swab or clean cloth.

(e) Avoid using Ketone type materials (e.g. Acetone), Toluene, Ethyl acid or Methyl chloride to clean the display surface. It might damage the touch panel surface permanently. The recommended solvents are water and Isopropyl alcohol.

(f) Wipe off water droplets or oil immediately.

(g) Protect the LCD module from ESD. It will damage the LSI and the electronic circuit.

(h) Do not touch the output pins directly with bare hands.

(i) Do not disassemble the LCD module.

(j) Do not lift the FPC of Touch Panel.

Storage

(a) Do not leave the LCD modules in high temperature, especially in high humidity for a long time.

(b) Do not expose the LCD modules to sunlight directly.

(c) The liquid crystal is deteriorated by ultraviolet. Do not leave it in strong ultraviolet ray for a long time.

(d) Avoid condensation of water. It may cause improper operation.

(e) Please stack only up to the number stated on carton box for storage and transportation. Excessive weight will cause deformation and damage of carton box.

Operation

(a) When mounting or dismounting the LCD modules, turn the power off.

(b) Protect the LCD modules from electric shock.

(c) The Driver IC control algorithms stated above should always obeyed to avoid damaging the LSI and electronic circuit.

(d) Be careful to avoid mixing up the polarity of power supply for backlight.

(e) Absolute maximum rating specified above has to be always kept in any case. Exceeding it may cause non-recoverable damage of electronic components or, nevertheless, burning.

(f) When a static image is displayed for a long time, remnant image is likely to occur.

(g) Be sure to avoid bending the FPC to an acute shape, it might break FPC.

(h) Most of the touch screens have air vent to equalize the inside air pressure to the outside one. The air vent must be open and liquid contact must be avoided as the liquid may be absorbed if the liquid is accumulated near the air vent.

(i) For the fragility of ITO film, it should avoid to use too tapering pen as the input material.

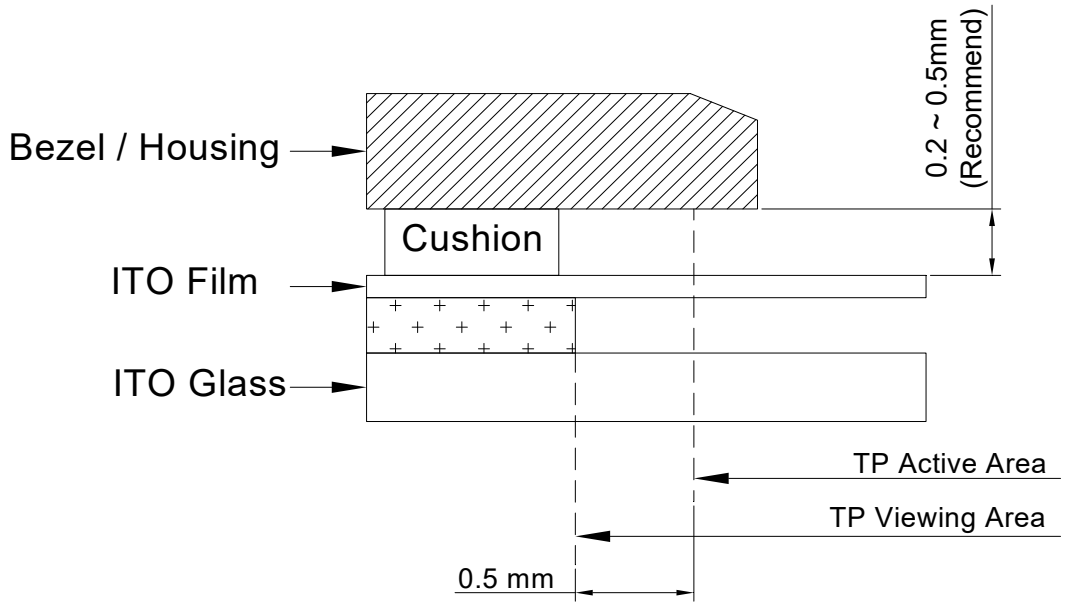
Touch Panel Mounting Notes

(a) If a cushion is used between bezel/housing and film must be choose as free as enough to absorb the expansion and contraction to avoid the distortion of film.

(b) The cushion must be placed out of the Viewing Area.

(c) Bezel/Housing edge must be posited between Key Area and Viewing Area. The edge enters the Key Area may cause unexpected input if the gap is too narrow or foreign particles like dusts exist between Bezel/Housing and ITO film.

(d) Mounting example:



The corner part has conductivity. Do not touch any metal part after mounting.

Others

a) If the liquid crystal leaks from the panel, it should be kept away from the eyes or mouth.

b) For the fragility of polarizer, it is recommended to attach a transparent protective plate over the display surface.

c) It is recommended to peel off the protection film on the polarizer slowly so that the electrostatic charge can be minimized.