



RAYSTAR

RAYSTAR Optronics, Inc.
曜凌光電股份有限公司



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RFJ240M-ALW-DNS

SPECIFICATION

CUSTOMER:

APPROVED BY	
PCB VERSION	
DATE	

FOR CUSTOMER USE ONLY

SALES BY	APPROVED BY	CHECKED BY	PREPARED BY

Release DATE:

TFT Display Inspection Specification: <https://www.raystar-optronics.com/download/products.htm>
Precaution in use of TFT module: <https://www.raystar-optronics.com/download/declaration.htm>

Revision History

VERSION	DATE	REVISED PAGE NO.	Note
0	2021/11/01		First issue

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2.Summary

TFT 2.4" is a TN transmissive type color active matrix TFT liquid crystal display that use amorphous silicon TFT as switching devices. This module is composed of a TFT_LCD module, It is usually designed for industrial application and this module follows RoHs,

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3.General Specifications

- Size: 2.4" inch
- Dot Matrix: 240 x RGB x 320(TFT) dots
- Module dimension: 42.72(W) x 60.26(H) x 3.43(D) mm
- Active area: 36.72 x 48.96 mm
- Pixel Pitch: 0.153 x 0.153 mm
- LCD type: TFT, Normally White, Transmissive
- TFT Interface: SPI
- TFT Driver IC: ST7789V or Equivalent
- View Direction: 6 o'clock
- Gray Scale Inversion Direction: 12 o'clock
- Aspect Ratio: Portrait
- Backlight Type: LED, Normally White
- With /Without TP: With RTP
- Surface: Anti-Glare

*Color tone slight changed by temperature and driving voltage.

4.Interface

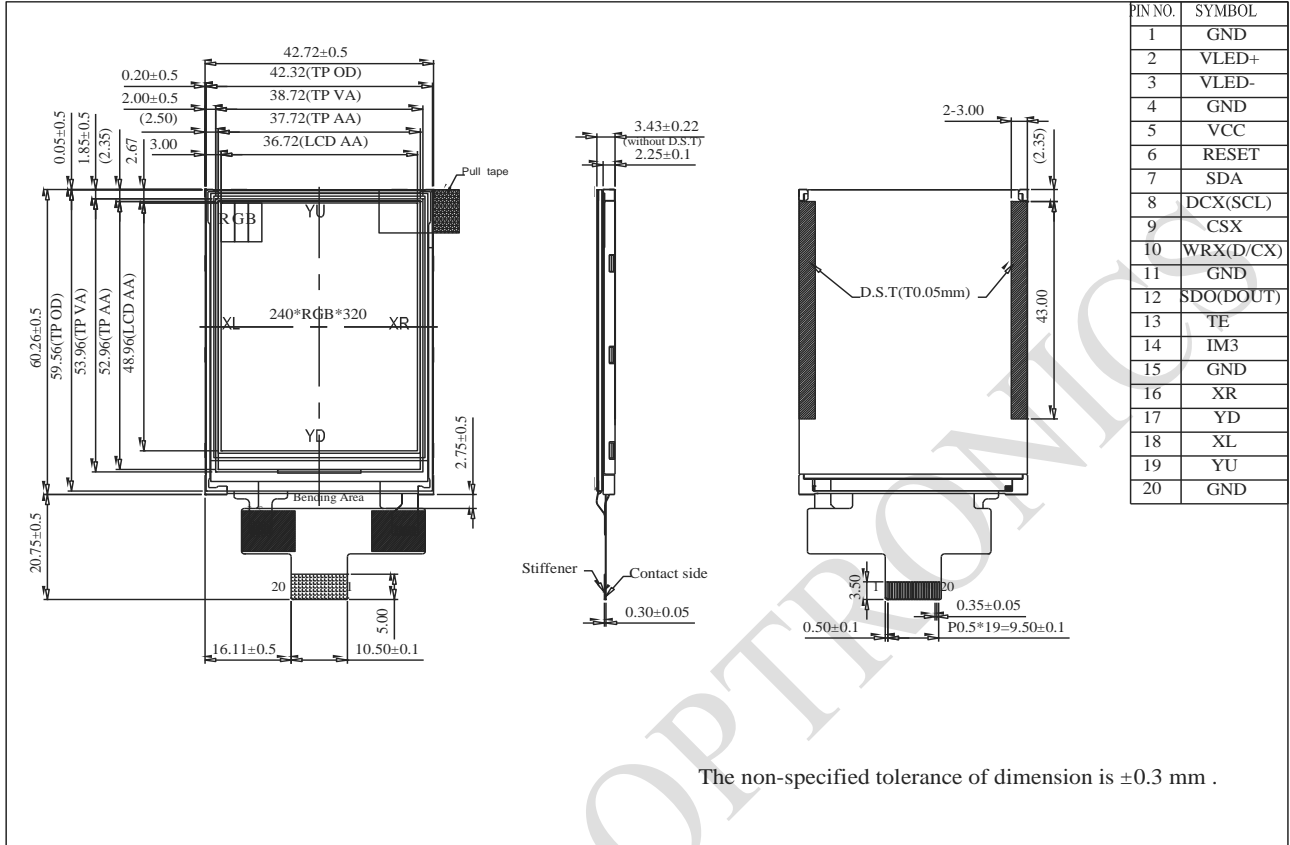
4.1. LCM PIN Definition

NO	Symbol	Function																		
1	GND	Ground																		
2	VLED+	Anode of LED backlight.																		
3	VLED-	Cathode of LED backlight.																		
4	GND	Ground																		
5	VCC	Power supply																		
6	RESET	System reset pin. (RESX) signal is active low																		
7	SDA	When IM3: Low, SPI interface input/output pin. When IM3: High, SPI interface input pin. The data is latched on the rising edge of the SCL signal. If not used, please fix this pin at VDDI or DGND level.																		
8	DCX(SCL)	This pin is used to be serial interface clock. DCX='1': display data or parameter. DCX='0': command data. If not used, please fix this pin at VDDI or DGND.																		
9	CSX	Chip selection pin Low enable. High disable.																		
10	WRX(D/CX)	Display data/command selection pin in 4-line serial interface. Second Data lane in 2 data lane serial interface. If not used, please fix this pin at VDDI or DGND.																		
11	GND	Ground																		
12	SDO(DOUT)	SPI interface output pin. The data is output on the falling edge of the SCL signal. If not used, let this pin open.																		
13	TE	Tearing effect signal is used to synchronize MCU to frame memory writing. If not used, please let this pin open																		
14	IM3	The MCU interface mode select. <table border="1" data-bbox="523 1688 1465 1921"> <thead> <tr> <th>IM3</th> <th>IM2</th> <th>IM1</th> <th>IM0</th> <th>MPU Interface Mode</th> <th>Data pin</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>4-line 8bit serial I/F</td> <td>SDA: in/out</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>4-line 8bit serial I/F II</td> <td>SDA:in/ SDO: out</td> </tr> </tbody> </table>	IM3	IM2	IM1	IM0	MPU Interface Mode	Data pin	0	1	1	0	4-line 8bit serial I/F	SDA: in/out	1	1	1	0	4-line 8bit serial I/F II	SDA:in/ SDO: out
IM3	IM2	IM1	IM0	MPU Interface Mode	Data pin															
0	1	1	0	4-line 8bit serial I/F	SDA: in/out															
1	1	1	0	4-line 8bit serial I/F II	SDA:in/ SDO: out															
15	GND	Ground																		
16	XR	Right electrode																		
17	YD	Bottom electrode																		

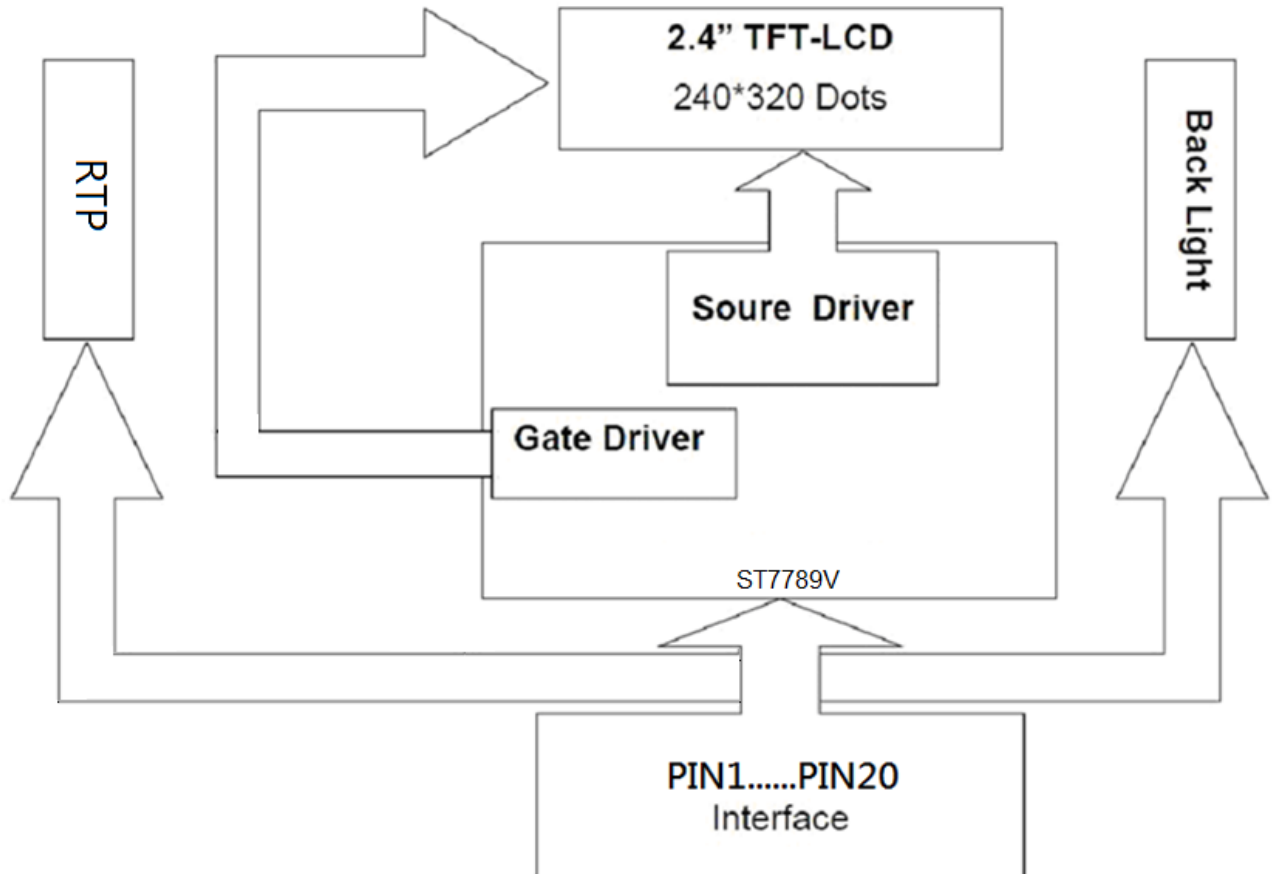
18	XL	Left electrode
19	YU	Top electrode
20	GND	Ground

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5. Contour Drawing



6. Block Diagram



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7. Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	TOP	-20	—	+70	□
Storage Temperature	TST	-30	—	+80	□

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

- Temp. □60□, 90% RH MAX. Temp. > 60□, Absolute humidity shall be less than 90% RH at 60□

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8. Electrical Characteristics

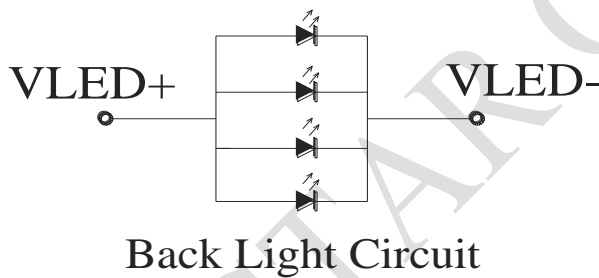
8.1. Operating conditions

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Analog	V _{cc}	—	2.4	3.3	3.6	V
Supply Current For LCM	I _{cc}	—	—	6.4	9.6	mA

8.2. LED driving conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED current	—	—	80	—	mA	—
Power Consumption	—	—	256	—	mW	—
LED voltage	V _{LED+}	2.8	3.1	3.3	V	Note 1
LED Life Time	—	—	50,000	—	Hr	Note 2,3,4

Note 1 : There are 1 Groups LED



Note 2 : T_a = 25 °C

Note 3 : Brightness to be decreased to 50% of the initial value

Note 4 : The single LED lamp case

9.AC Characteristics

9.1. Serial Interface Characteristics (4-line serial)

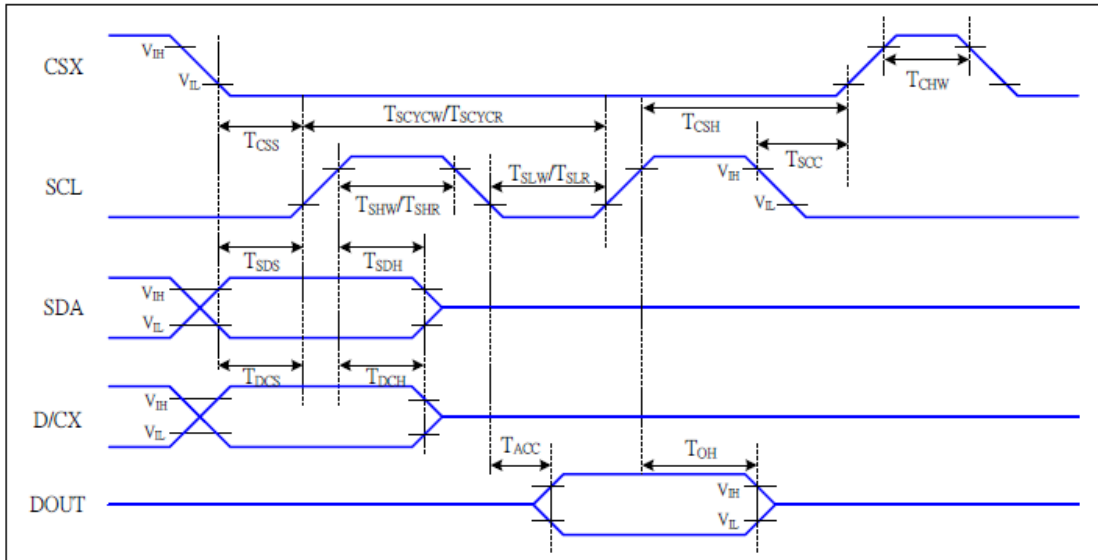


Figure 1 4-line serial Interface Timing Characteristics

VDDI=1.65 to 3.6V, VDD=2.4 to 3.6V, AGND=DGND=0V, Ta=25 °C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T _{css}	Chip select setup time (write)	15		ns	
	T _{sch}	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 _{ch}	Chip select "H" pulse width	40		ns	
SCL	T _{scy}	Serial clock cycle (Write)	16		ns	-write command & data ram
	T _{sh}	SCL "H" pulse width (Write)	7		ns	
	T _{sl}	SCL "L" pulse width (Write)	7		ns	
	T _{scy}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T _{sh}	SCL "H" pulse width (Read)	60		ns	
	T _{sl}	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 _{sd}	Data setup time	7		ns	
	T _{sdh}	Data hold time	7		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

Table 1 4-line serial Interface Characteristics

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.

9.2. Reset Timing:

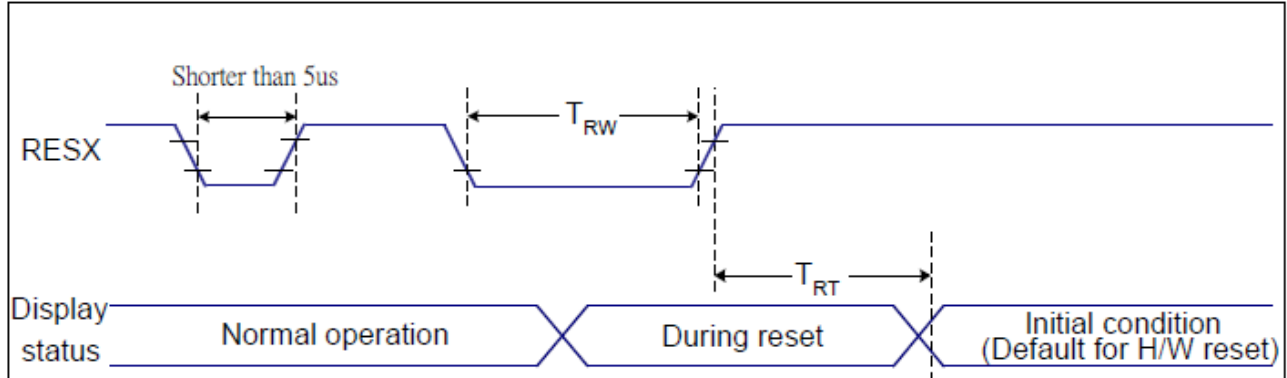


Figure 2 Reset Timing

VDDI=1.65 to 3.6V, VDD=2.4 to 3.6V, AGND=DGND=0V, Ta=25 °C

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESXline does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.
4. Spike Rejection also applies during a valid reset pulse as shown below:

10. Optical Characteristics

Item	Symbol	Condition.	Min	Typ.	Max.	Unit	Remark	
Response time	Tr	$\theta=0^\circ$ 、 $\Phi=0^\circ$	-	4	8	ms	Note 3	
	Tf		-	12	24	ms		
Contrast ratio	CR	At optimized viewing angle	400	500	-	-	Note 4	
Color Chromaticity	White	Wx	$\theta=0^\circ$ 、 $\Phi=0^\circ$	0.253	0.303	0.353	Note 2,6,7	
		Wy		0.275	0.325	0.375		
Viewing angle (Gray Scale Inversion Direction)	Hor.	Θ_R	$CR \geq 10$	35	45	-	Deg.	Note 1
		Θ_L		35	45	-		
	Ver.	Φ_T		35	45	-		
		Φ_B		10	20	-		
Brightness	-	-	250	350	-	cd/m ²	Center of display	
Uniformity	(U)	-	75	-	-	%	Note5	

Ta=25±2°C

Note 1: Definition of viewing angle range

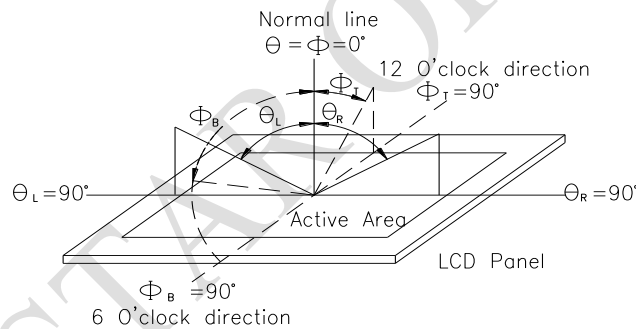


Fig. 10.1. Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 or BM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

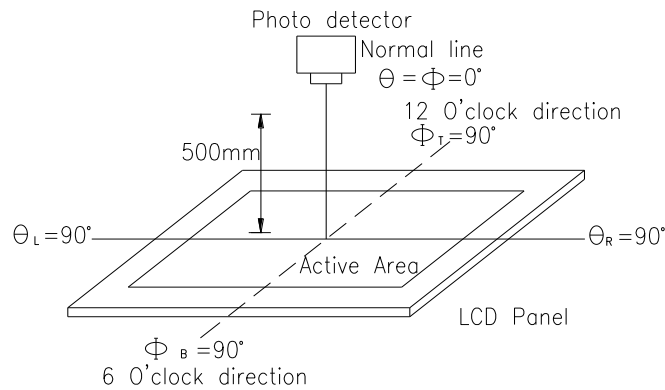
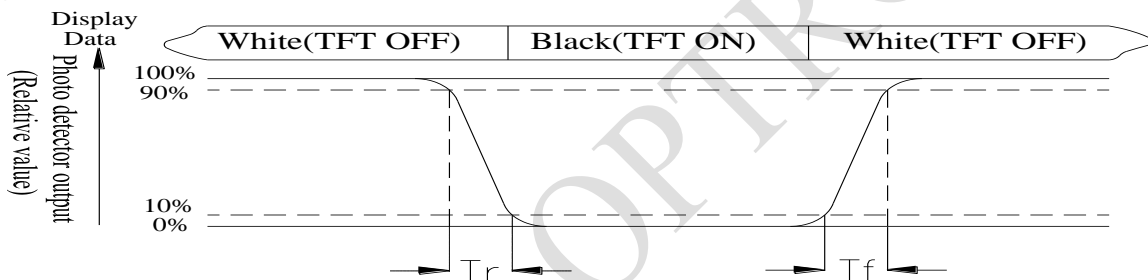


Fig. 10.2. Optical measurement system setup

Note 3: Definition of Response time:

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time, T_r , is the time between photo detector output intensity changed from 90% to 10%. And fall time, T_f , is the time between photo detector output intensity changed from 10% to 90%



Note 4: Definition of contrast ratio:

The contrast ratio is defined as the following expression.

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

Note 5: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (reference the picture in below). Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (U)} = L_{\min}/L_{\max} \times 100\%$$

L = Active area length

W = Active area width

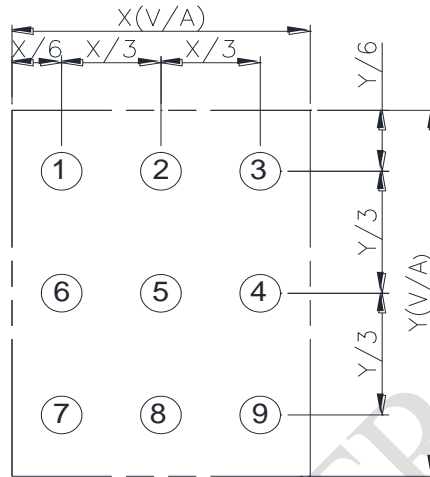


Fig 10.3. Definition of uniformity

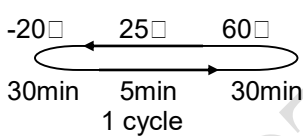
Note 6: Definition of color chromaticity (CIE 1931)

Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

11. Reliability

Content of Reliability Test (Wide temperature, -20□~70□)

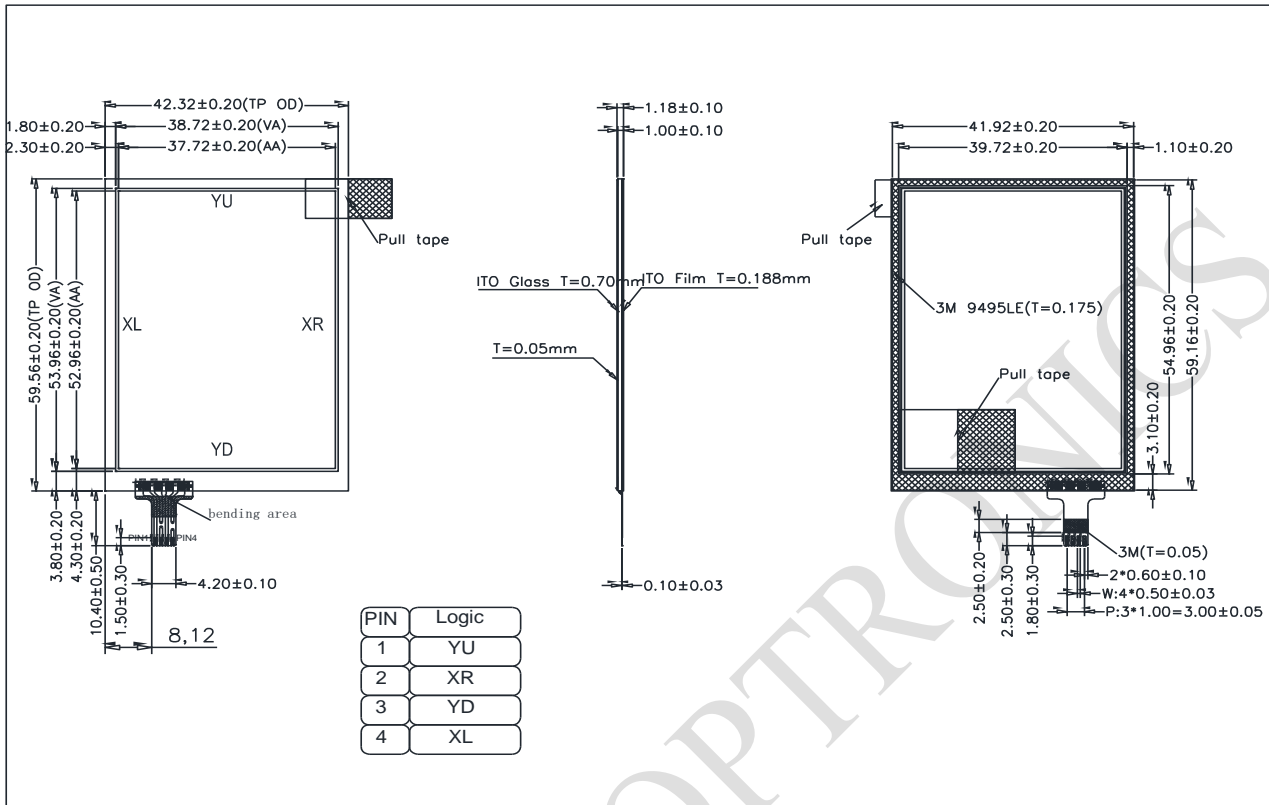
Environmental Test			
Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80□ 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30□ 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70□ 96hrs	—
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20□ 96hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60□,85%RH max	60□,85%RH 96hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation <div style="text-align: center;">  </div>	-20□/60□ 10 cycles	—
Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes	3
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=±600V(contact), ±800v(air), RS=330Ω CS=150pF 10 times	—

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.

12.Touch Panel Information



12.1. Resistance Touch Panel General Specifications

Item	Description
Driving condition	DC5V
Operating force	20~100g
Linearity max	≤ 1.5%
Insulating resistance	> 20MΩ · 25V(DC)
Light transporence	70%
Structure type	ITO Film/ITO Glass(F/G)
Surface Hardness	3H typ
Pen Hitting Durability (with the silicon rubber)	> 1000,000 times
X resistance	150~600Ω
Y resistance	200~900Ω

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LCM Sample Estimate Feedback Sheet

Module Number : _____

1 、 Panel Specification :

1. Panel Type :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
2. View Direction :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
3. Numbers of Dots :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
4. View Area :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
5. Active Area :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
6. Operating Temperature :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
7. Storage Temperature :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
8. Others :	_____	

2 、 Mechanical Specification :

1. PCB Size :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
2. Frame Size :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
3. Material of Frame :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
4. Connector Position :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
5. Fix Hole Position :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
6. Backlight Position :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
7. Thickness of PCB :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
8. Height of Frame to PCB :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
9. Height of Module :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
10. Others :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____

3 、 Relative Hole Size :

1. Pitch of Connector :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
2. Hole size of Connector :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
3. Mounting Hole size :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
4. Mounting Hole Type :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
5. Others :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____

4 、 Backlight Specification :

1. B/L Type :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
2. B/L Color :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
3. B/L Driving Voltage (Reference for LED Type) :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
4. B/L Driving Current :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
5. Brightness of B/L :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
6. B/L Solder Method :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
7. Others :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____

>> Go to page 2 <<

Module Number : _____

5、Electronic Characteristics of Module :

1.Input Voltage :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
2.Supply Current :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
3.Driving Voltage for LCD :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
4.Contrast for LCD :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
5.B/L Driving Method :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
6.Negative Voltage Output :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
7.Interface Function :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
8.LCD Uniformity :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
9.ESD test :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____
10.Others :	<input type="checkbox"/> Pass	<input type="checkbox"/> NG , _____

6、Summary :

Sales signature : _____

Customer Signature : _____

Date : / /

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