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## **SPECIFICATION FOR TFT MODULE**

**MODULE NO. : AFV240240A1P-1.5IWTM**

### **Customer Approval:**

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	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

**Notes:**

1. Please contact ORIENT before assigning your product based on this module specification.
2. To improve the quality of product, and this product specification is subject to change without any notice.

## REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
V01	2015-03-12	First release	Preliminary
V02	2015-03-16	Second release	P.4,P.6

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## 1. GENERAL INFORMATION

No.	Item of general information	Contents	Unit
1	LCD size	1.54 inch ( Diagonal )	/
2	LCD type	TFT/TRANSMISSIVE/ Normal Black	/
3	View direction	All	/
4	Gray scale inversion direction	-- O'clock	/
5	Resolution	240 RGB(H)*240(V)	/
6	Module size (W*H*T)	31.82(W)×33.72(H)×1.147(T)	mm <sup>3</sup>
7	Active area (W*H)	27.72*27.72	mm <sup>2</sup>
8	Pixel Size (W*H)	0.1155*0.1155	mm <sup>2</sup>
9	Interface Type	8080 Mcu 8bit Interface	/
10	Input voltage	3.3V	V
11	Module Power consumption	TBD	w
12	Back light Type	LED	/
13	Driver IC	ILI9341 or compatible	/
14	Weight	TBD	g

## 2.ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Power supply voltage(LCD Module)	VDD	-0.3	4.6	V
Back-light current (normal temp.)	ILED	-	50	mA
Power voltage(TP)	VTP	-	-	V
Operation temperature	Top	-20	70	°C
Storage temperature	Tst	-30	80	°C
Humidity	RH	-	90%(Max60 °C)	RH

## 3. ELECTRICAL CHARACTERISTICS

### DC CHARACTERISTICS ( at Ta=25°C )

Parameter	Symbol	Min	Typ	Max	Unit	note
Power Supply Input Voltage	VDD	2.5	2.8	3.3	V	
I/O logic voltage	VDDIO	1.65	2.8	3.3	V	
Power Supply Current	I	-	TBD	-	mA	
Input voltage 'H' level	VIH	0.7*VDDIO	-	VDDIO	V	
Input voltage 'L' level	VIL	0	-	0.3VDDIO	V	

## 4. BACKLIGHT CHARACTERISTICS (at Ta=25°C,RH=60%)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Voltage	VF	2.9	-	3.4	V	
LED Forward Current	IF	-	40	-	mA	
LED power consumption	PLED	-	0.128	-	W	Note1
Number of LED	-		2		Piece	
Connection mode	-	2 in parallel			/	
LED Life-Time	-	20,000	-	-	Hrs	Note2

Note:

1. Calculator Value for reference  $I_{LED} \times V_{LED} \times \text{LED Quantity} = P_{LED}$
2. The LED Life-time define as the estimated time to 50% degradation of initial brightness at Ta=25°C and IF =40mA. The LED lifetime could be decreased if operating IF is larger than 40 mA.

## 5. TOUCH PANEL CHARACTERISTICS (at Ta=25°C)

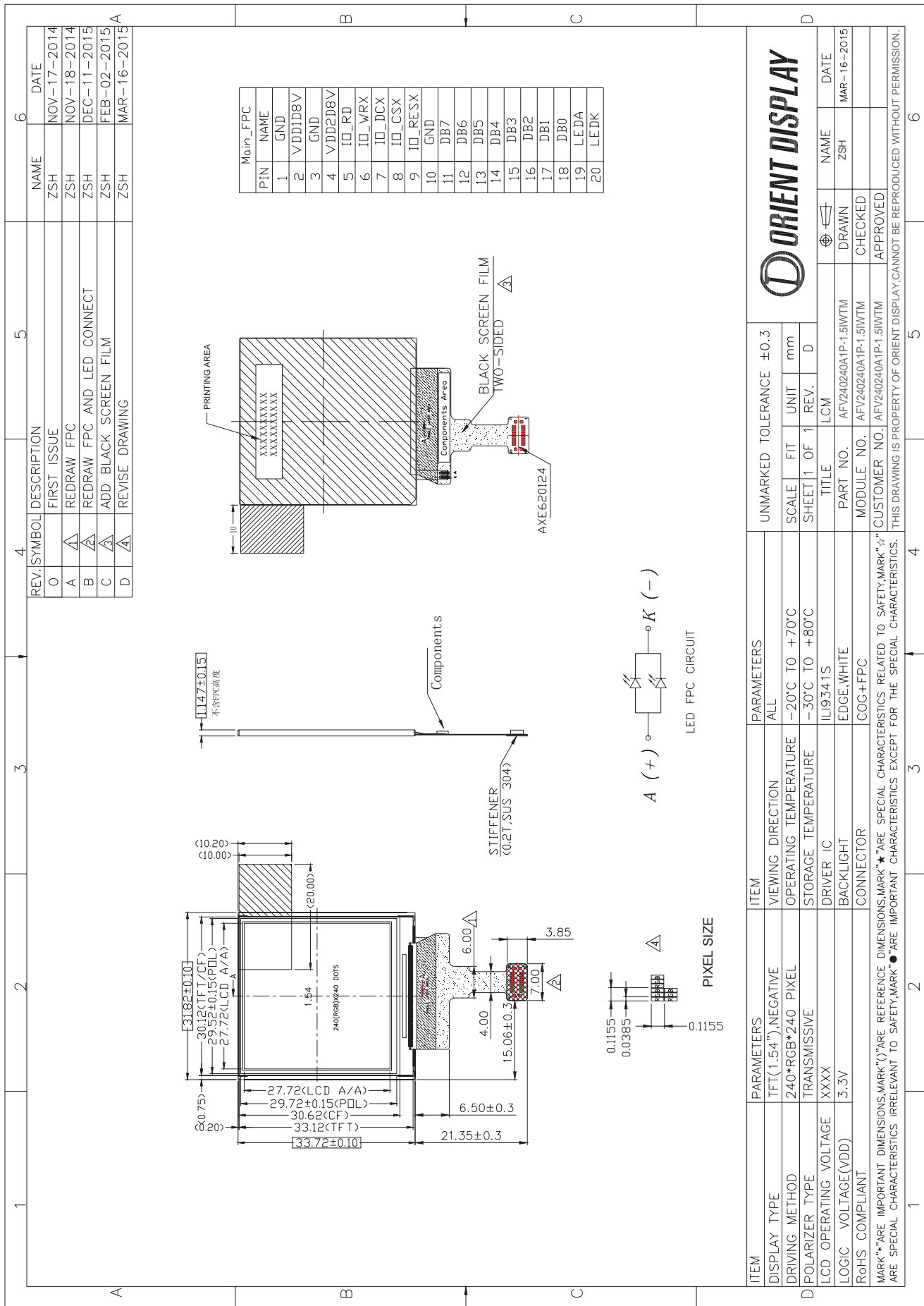
FPC Design	Item	Description	Note
[√] COF	IC solution on TP Model	-	
	Touch Count Max	-	
	Display Resolution*	-	
	Interface Type *	-	
	I2C Slave Address*	-	
	Origin of Coordinate*	-	
[ ] COB	IC solution on Broad*		
	Driving Channels		
	Sensing Channels		

Parameter	Min	Typ	Max	Unit
Interface Signal Voltage*	-	-	--	V
Power Voltage*	-	-	-	V
Power ripple*	---	---	-	MV

Note1: The detail refer to the Specification For IC

Note2: “\*”means that the item is optional according to the product requirement

## 6. EXTERNAL DIMENSIONS



## 7. ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr+ Tf	-	—	35	—	ms	Fig.1	4
Contrast ratio	Cr		-	900	—	---	FIG 2.	1
Surface Luminance	Lv	$\theta=0^\circ$	360	450	—	cd/m2	FIG 2.	2
Luminance uniformity	-	$\theta=0^\circ$	80	85	-	%	FIG 2.	3
NTSC	-	$\theta=0^\circ$	-	50	-	%	FIG 2.	5
Viewing angle range	$\theta$	$\varnothing = 90^\circ$	-	80	—	deg	FIG 3.	6
		$\varnothing = 270^\circ$	-	80	—	deg	FIG 3.	
		$\varnothing = 0^\circ$	-	80	—	deg	FIG 3.	
		$\varnothing = 180^\circ$	-	80	—	deg	FIG 3.	
CIE (x, y) chromaticity	Red x	$\theta=0^\circ$ $\varnothing=0^\circ$ $T_a=25^\circ\text{C}$	TYP-0.04	0.609	TYP+0.04	-	FIG 2. CIE1931	5
	Red y			0.337		-		
	Green x			0.347		-		
	Green y			0.562		-		
	Blue x			0.152		-		
	Blue y			0.124		-		
	White x			0.319		-		
	White y			0.365		-		

### Note1. Definition of contrast ratio

Contrast Ratio(CR) is defined mathematically by the following formula. For more information see FIG 2.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)}}$$

### Note2. Definition of surface luminance

Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

$L_v$  = Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)

### Note3.Definiton of luminance uniformity

The luminance uniformity in surface luminance ( $\delta$  WHITE ) is determined by measuring luminance at each test position 1 through 9, and then dividing the maximum luminance of 9 points luminance by minimum luminance of 9 points luminance. For more information see FIG 2.

$$Y_u = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5,P6,P7,P8,P9)}}$$

### Note4. Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time ( $T_{ON}$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_{OFF}$ ) is the time between photo detector output intensity changed from 10% to 90%.For additional information see FIG1.

### Note5. Definition of color chromaticity (CIE1931)

CIE (x, y) chromaticity ,The x,y value is determined by screen active area center position P5, For more information see FIG 2.

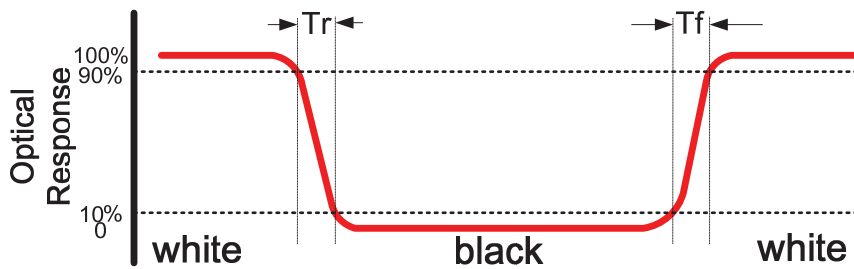
### Note6. Definition of Viewing ange.

Viewing angle is the angle at which the contrast ratio is greater than 10. 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 FIG 3.

For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope or DMS series Instruments or compatible. For contrast ratio, Surface Luminance, Luminance uniformity and CIE,the testing data is base on TOPCON's BM-7 or BM-5 photo detector or compatible.

**Note:** For TFT module, Gray scale reverse occurs in the direction of panel viewing angle.

**FIG.1. The definition of Response Time**



**FIG.2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity**

Size:  $S \leq 5"$  (see figure a)

A : 5 mm B : 5 mm

H,V : Active Area

Light spot size  $\varnothing=5\text{mm}$ , 500mm distance or compatible distance from the LCD surface to detector lens.

test spot positon: see figure a.

measurement instrument : TOPCON's luminance meter BM-5 or BM-7 or compatible (see figure c)

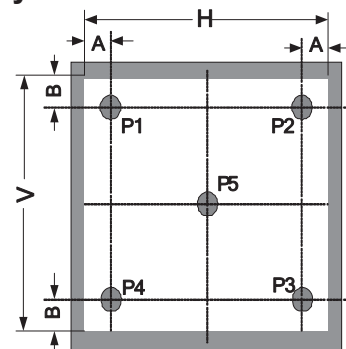


Figure a

Size:  $5" < S \leq 12.3"$  (see figure b)

H,V : Active Area

Light spot size  $\varnothing=5\text{mm}$ , 500mm distance or compatible distance from the LCD surface to detector lens

test spot positon: see figure b

measurement instrument : TOPCON's luminance meter BM-5 or BM-7 or compatible (see figure c)

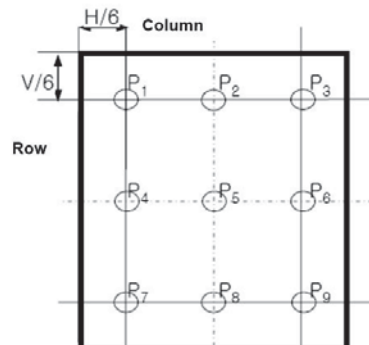
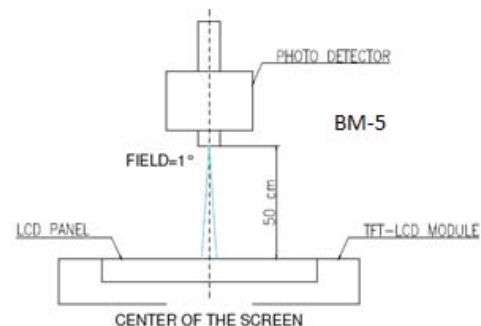
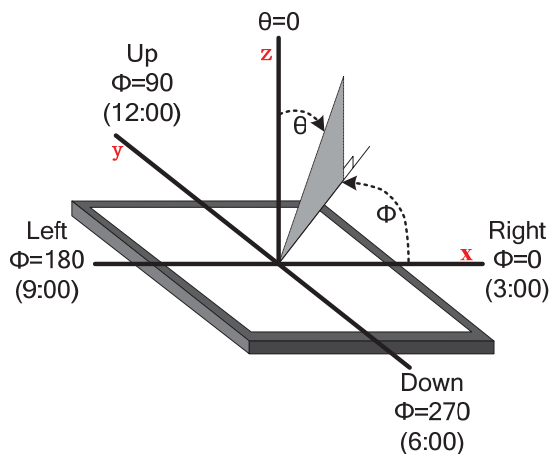


Figure b

### The definition of viewing angle



Figure



## 8. INTERFACE DESCRIPTION

### LCM Interface description

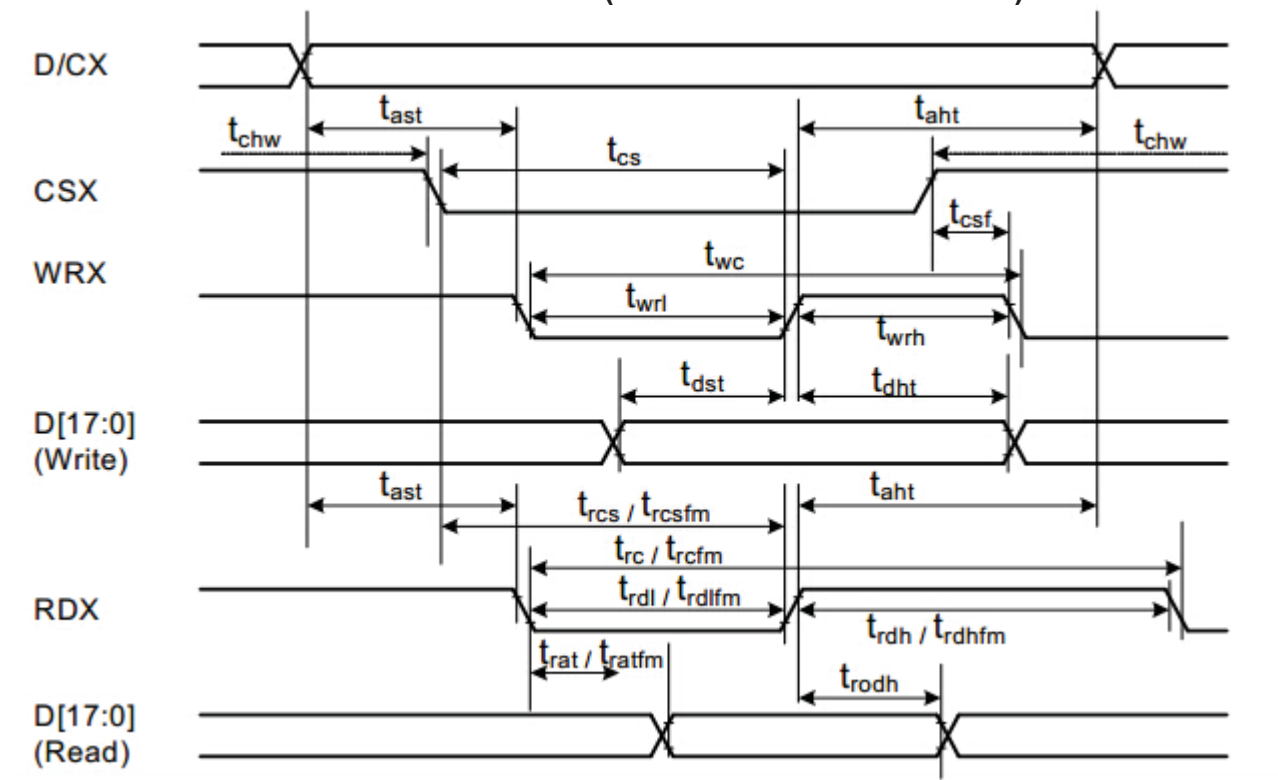
Interface NO.	NAME	I/O or connect to	DESCRIPTION
1	GND	P	Ground
2	VDD1D8V	P	Power supply to the internal logic
3	GND	P	Ground
4	VDD2D8V	P	Power supply to the internal Analog
5	IO_RD	I	Read execution control pin
6	IO_WRX	I	Write execution control pin
7	IO_DCX	P	Data/Command control pin
8	IO_CSX	I	Chip select pin
9	IO_RESX	I	Reset signal pin
10	GND	P	Ground
11	DB7	I/O	Data Bus
12	DB6		
13	DB5		
14	DB4		
15	DB3		
16	DB2		
17	DB1		
18	DB0		
19	LEDA	P	Power supply Anode input for backlight
20	LEDK	P	Power supply Cathode input for backlight

### TP Interface description

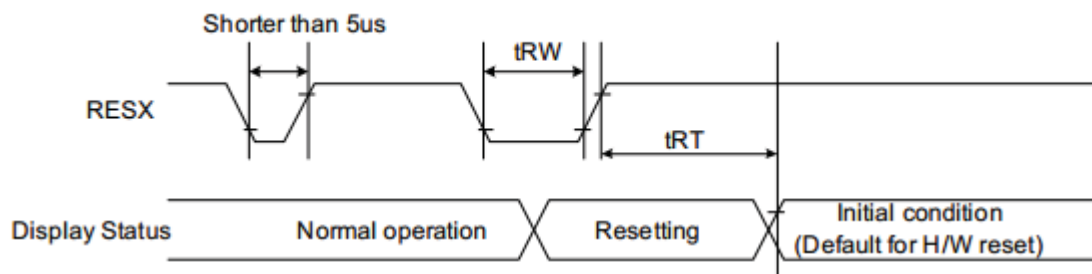
Interface NO.	NAME	I/O or connect to	DESCRIPTION
1			
2			
3			
4			
5			
6			
7-10			

## 9. AC CHARACTERISTICS

### 9.1 Parallel Interface Characteristics:(8080 Series MCU Interface)



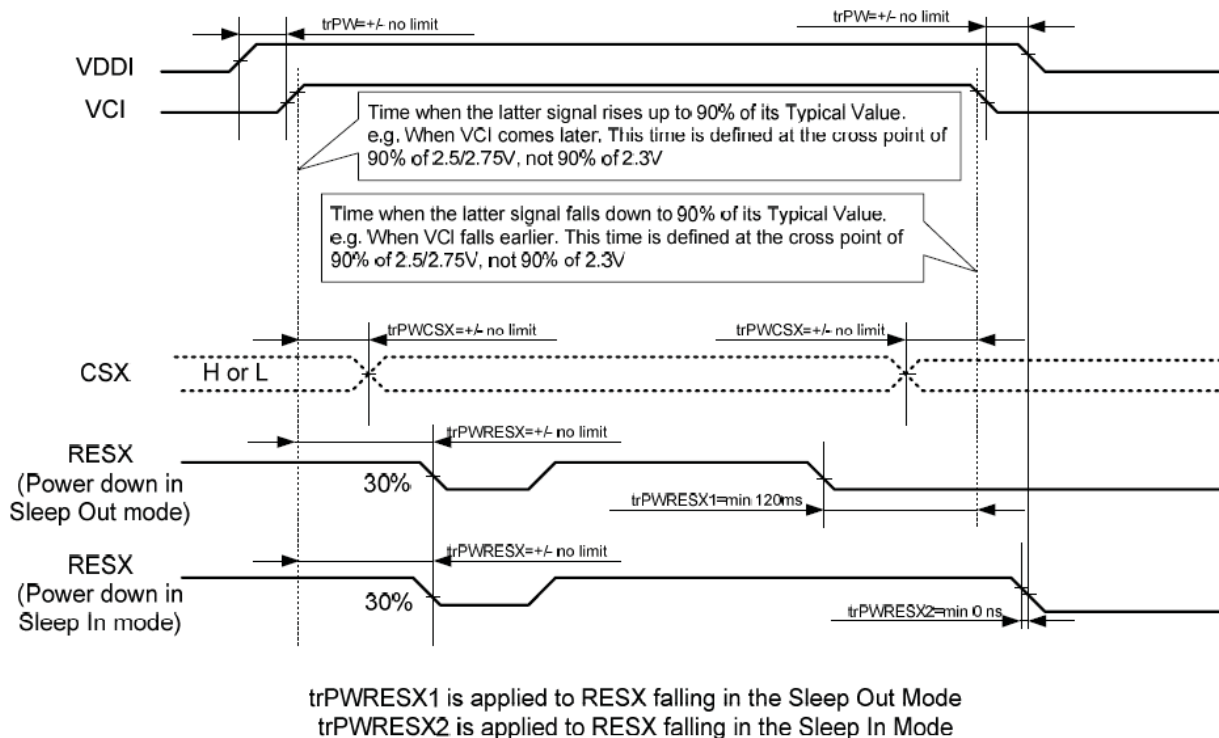
### 9.2 Reset timing



Signal	Symbol	Parameter	Min	Max	Unit
RESX	$t_{RW}$	Reset pulse duration	10		$\mu$ S
	$t_{RT}$	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

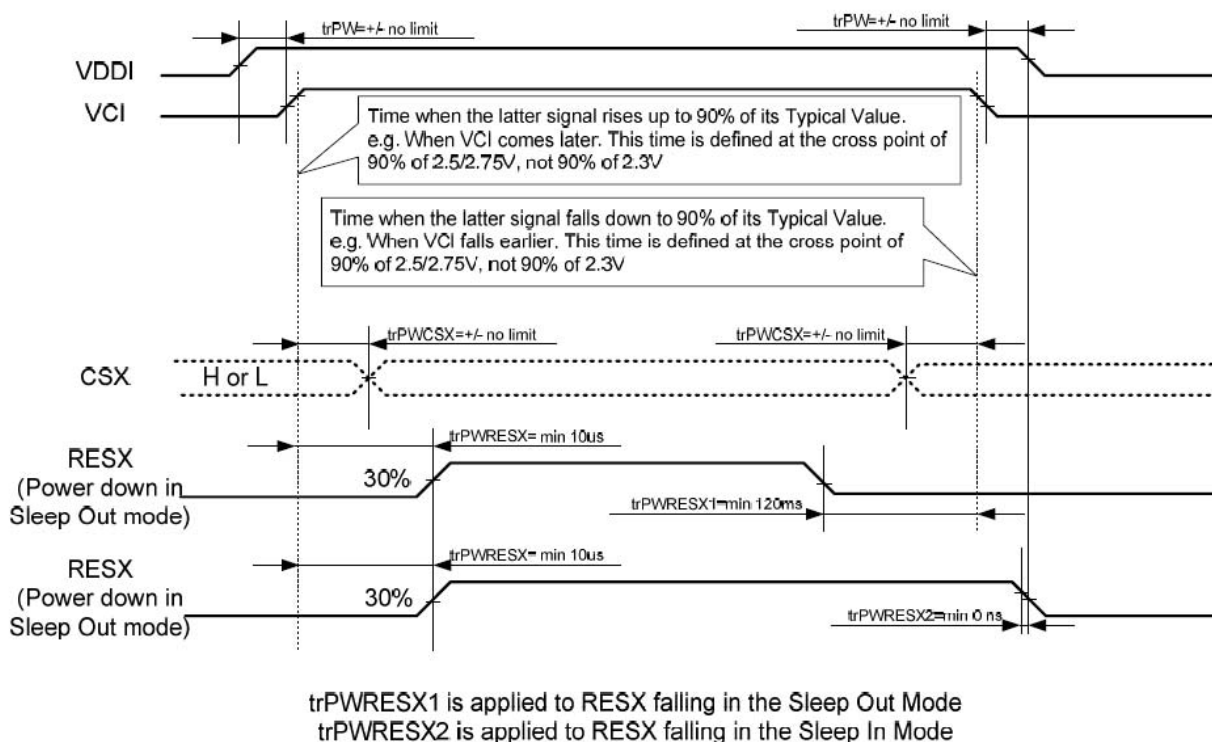
## 10. POWER SEQUENCE

### Case 1 – RESX line is held High or Unstable by Host at Power ON



Note 1: Unless otherwise specified, timings herein show cross point at 50% of signal power level.

### Case 2 – RESX line is held Low by Host at Power ON



Note 1: Unless otherwise specified, timings herein show cross point at 50% of signal power level.

## 11. RELIABILITY TEST CONDITIONS

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	80±2°C/240 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Current changing value before test and after test is 50% larger ; 2. function defect:Non-display ,abnormal-display,missing lines,Short lines , ITO corrosion ; 3.visual defect:Air bubble in the LCD,Sealleak,Glass crack.
2	Low Temperature Storage	-30±2°C/240 hours	
3	High Temperature Operating	70±2°C/120 hours	
4	Low Temperature Operating	-20±2°C/120 hours	
5	Temperature Cycle	-20±2°C~25~70±2°C×10cycles (30min.) (5min.) (30min.)	
6	Damp Proof Test	50°C×90% RH/120 hours	
7	Vibration Test	Frequency : 10Hz~55Hz~10Hz Amplitude : 1.5mm, X ,Y ,Z direction for total 3hours (Packing condition)	
8	Dropping test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
9	ESD test	Voltage:±8KV R: 330Ω C: 150pF Air discharge, 10time	

### Remark:

- 1.The test samples should be applied to only one test item.
- 2.Sample size for each test item is 3~5pcs.
- 3.For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.
- 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.
- 5.EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
- 6.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

## 12. INSPECTION CRITERION

### 12.1 description

This specification is made to be used as the standard acceptance/rejection criteria for TFT LCM Product.

#### 1 Sample plan

Sampling plan according to GB/T2828.1-2003/ISO 2859-1 : 1999 and ANSI/ASQC Z1.4-1993, normal level 2 and based on:

Major defect: AQL 0.65

Minor defect: AQL 1.5

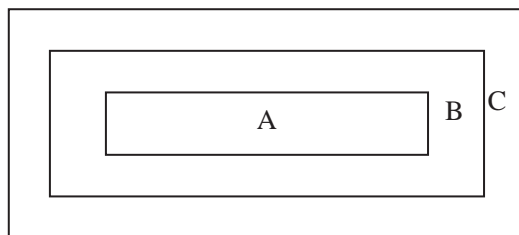
#### 2. Inspection condition

● Viewing distance for cosmetic inspection is about  $30\pm 5\text{cm}$  with bare eyes, and under an environment 600~1000lux for visual inspection and 0~200lux for function test., all directions for inspecting the sample should be within  $45^\circ$  against perpendicular line. (Normal temperature  $18\sim 28^\circ\text{C}$  and normal humidity  $60\pm 15\%\text{RH}$ ).

● Driving voltage

The Vop value from which the most optical contrast can be obtained near the specified Vop in the specification (Within  $\pm 0.5\text{V}$  of the typical value at  $25^\circ\text{C}$ .).

#### 3. Definition of inspection zone in LCD.



Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)

Fig.1 Inspection zones in an LCD.

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

## 12.2 Inspection Standard

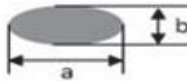
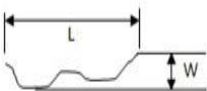
### 12.2.1 function defect

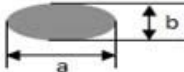
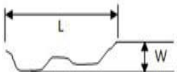
Items to be inspected	Inspection Standard	Classification of defects
All functional defects	1) No display 2) Display abnormally 3) Missing vertical , horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting. 6) obvious striation 7) Current beyond specification value	MA
Missing	Missing component	
Outline dimension	Overall outline dimension exceed the drawing is not allowed.	

### 12.2.2 LCD pixel defect ( bad dot) (defect type:MI)

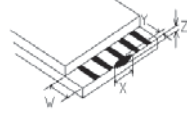
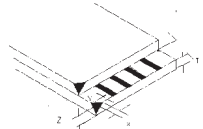
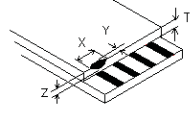
checking item	judgment standard		
Item\LCD size	S ≤5.0 Inch	5.0 < S≤7.0 Inch	7 < S≤12.3 Inch
Color bad dot-bright dot(R、G、B)	1	2	3
two adjacent bright point	0	1	2
three or more adjacent point	0	0	0
total points for bad dot-bright dot	1	2	5
Bad dot-dark dot	2	4	5
two adjacent dark point	1	2	3
three or more adjacent point	0	1	1
total points for bad dot -dark dot	3	6	7
patch bright dot	Invisible with ND5%,it is OK.		

### 12.2.3 dot and line defect(defect type:MI )

Checking item	Judgment Criterion				figure	
	Diameter(mm)\LCD Size	S ≤5.0 Inch	5 < S≤7 Inch	7 < S≤12.3 Inch		
Dot defect	D≤0.1	allowed	allowed	allowed	 D=(a+b)/2	
	0.1 < D≤0.2	4	allowed	allowed		
	0.2 < D≤0.3	0	5	6		
	0.3 < D≤0.5	0	0			
	D > 0.5	0	0	0		
	the distance between the two defect dot:DS≥5mm					
line defect	Length(mm)	width(mm)	Judgment standard			
	disregard	W≤0.05	allowed	allowed		allowed
	L≤5	0.05 < W≤0.1	4	5		7

	L > 5	W > 0.1	0	0	0	
Concave point and air bubble for polarizer	LCD SIZE ( mm)		Judgment Criterion			 D=(a+b)/2
	D≤0.3		allowed	allowed	allowed	
	0.3 < D≤1.0		3	4	5	
	1.0 < D≤1.5		1	2	3	
	D > 1.5		0	0	0	
Fold mark, linear scar for polarizer	length ( mm)	width ( mm)	Judgment Criterion			
	disregard	W≤0.05	allowed	allowed	allowed	
	1 < L≤5	0.05 < W≤0.2	3	4	5	
	L > 5	W > 0.2	0	0	0	
	Notes:1.If the fold mark and linear scar for polarizer is visible with operating condition,the defect is judged with line judge ; 2.If the fold mark and linear scar for polarizer is visible with non-operating condition,the defect is judged with the above judgment standard.					

#### 12.2.4 Corner and others crack for LCD (defect type:MI)

Checking item	judgment criterion	figure
electric conduction crack	$X \leq 3.0\text{mm}, Y \leq 1/4w, Z \leq t, N \leq 2$	
corner crack	$X \leq 3.0\text{mm}, Y \leq 3.0\text{mm}, Z \leq t, N \leq 3$ Corner crack extended to ITO PIN, none allowed	
surface crack	$X \leq 1.5\text{mm}, Y \leq 1.0\text{mm}, Z \leq t, N \leq 4$	

#### 12.2.5 Module Cosmetic Criteria (defect type:MI)

Item	Judgment Criterion
Difference in Spec.	None allowed
Pattern peeling	No substrate pattern peeling and floating
Soldering defects	No soldering missing No soldering bridge No cold soldering Notes: detail judgment referring to IPC-A-610 grade II
Resist flaw on Printed Circuit Boards	visible copper foil ( 0.5mm or more) on substrate pattern, none allowed
Accretion of metallic Foreign matter	No accretion of metallic foreign matters (Not exceed 0.2mm)
Stain	No stain to spoil cosmetic badly
Plate discoloring	No plate fading, rusting and discoloring
Newton ring	Referring to limited sample

Mura	Invisible with 5%ND,allowed
Light leaks	Referring to limited sample

## 13. Handling Precautions

### 13.1 Mounting method

The LCD module consists of two thin glass plates with polarizes which easily be damaged. And since the module is so constructed as to be fixed by utilizing fitting holes in the printed circuit board.

Extreme care should be needed when handling the LCD modules.

### 13.2 Caution of LCD handling and cleaning

When cleaning the display surface, Use soft cloth with solvent

[recommended below] and wipe lightly

- .Isopropyl alcohol
- .Ethyl alcohol

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- .Water
- .Aromatics

Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns

Do not use the following solvent on the pad or prevent it from being contaminated:

- .Soldering flux
- .Chlorine (Cl) , Sulfur (S)

If goods were sent without being silicon coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

If ITO corrosion happens by miss-handling or using some materials such as Chlorine (Cl), Sulfur (S) from customer, Responsibility is on customer.

### 13.3 Caution against static charge

The LCD module uses C-MOS LSI drivers, so we recommend that you:

Connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

### 13.4 packing

Module employs LCD elements and must be treated as such.

- .Avoid intense shock and falls from a height.
- .To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity

### 13.5 Caution for operation

- .It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit causes the shorter LCD life.
- .An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.
- .Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.
- .If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- .A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the maximum operating temperature, 50%Rh or less is required.

### 13.6 storage

In the case of storing for a long period of time for instance, for years for the purpose or replacement use,



the following ways are recommended.

- Storing in an ambient temperature 10°C to 30°C, and in a relative humidity of 45% to 75%. Don't expose to sunlight or fluorescent light.
- Storing in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it . And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.
- Storing with no touch on polarizer surface by the anything else.

It is recommended to store them as they have been contained in the inner container at the time of delivery from us.

### **13.7 Safety**

- It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water

## **14. Precaution for use**

**14.1** A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

**14.2** On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

- When a question is arisen in this specification
- When a new problem is arisen which is not specified in this specifications
- When an inspection specifications change or operating condition change in customer is reported to ORIENT and some problem is arisen in this specification due to the change
- When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.

## **15. PACKING SPECIFICATION**

Please consult our technical department for detail information.