



## Product Specification

<b>Model Name</b>	LM028CQ04NS-DR01
<b>Description</b>	Standard LCD Module 2.8" QVGA 240x(RGB)x320 Dots
<b>Date</b>	2018/08/22
<b>Version</b>	1.0

- Preliminary Specification
- Final Product Specification

Prepared by	Checked by	Approved by
SXY 2018/08/22	SXY 2018/08/22	LX 2018/08/22

### For Customer Approval

Approved By	Comment



# 深圳市美显实业有限公司 LCD Mall Limited

## Table of Contents

1. Record of Revision .....	3
2. General Specifications .....	4
3. Input/OutputTerminals.....	5
4. Absolute Maximum Rating .....	6
5. Electrical Characteristics .....	6
6. Interface Timing .....	8
7. Optical Characteristics .....	12
8. Environmental / Reliability Tests.....	15
9. Mechanical Drawing .....	16
10. Packing.....	17
11. TFT-LCD Module Inspection Criteria .....	18
12. Precautions for Use of LCD modules.....	23





## 2. General Specifications

	Feature	Spec
Characteristics	Size	2.8 inch
	Resolution	240(horizontal)*320(Vertical)
	Interface	MCU&RGB
	Pixel pitch (mm)	0.180*0.180
	Pixel Configuration	R.G.B.-Stripe
	Display Mode	Normally White
	Display Colors	262K
	LCD Driver IC	ILI9341V
	CTP Driver IC	TBD
	Viewing Direction	6 O'clock
Mechanical	LCM (W x H x D) (mm)	50.00*69.20*2.55
	Active Area(mm)	43.20*57.60
	With /Without TSP	With RTP
	Weight (g)	TBD
	LED Numbers	4 LEDs

Note 1: Requirements on Environmental Protection: RoHs

Note 2: LCM weight tolerance: +/- 5%



### 3. Input/Output Terminals

#### LCD PIN-MAP

No.	Symbol	Description
1	LED_K1	Cathode of LED back light
2	LED_K2	Cathode of LED back light
3	LED_K3	Cathode of LED back light
4	LED_K4	Cathode of LED back light
5	LED_A	Anode of LED back light
6~9	IMO~IM3	Note
10	RESET	reset pin. Initializes the ILI9341V with a low input. Be sure to execute a power-on reset after supplying power
11	VSRNC	Vertical sync signal
12	HSYNC	Horizontal sync signal
13	DOTCLK	Anode of LED back light
14	ENABLE	Display enable pin
15~32	DB17~DB0	Data bus
33	SDO	Serial data output
34	SDI	Serial data input
35	RD	Read data signal
36	WR	A write strobe signal and enables an operation to write data when the signal is low
37	RS	A register select signal Low: select an index or status register, High: select a control regis
38	CS	A chip select signal. Low: the ILI9341V is selected and accessible. High: the ILI9341V is not selected and not accessible
39	FMARK	Tearing effective signal control
40	IOVCC	Power supply for logic voltage
41~42	VCI	Power supply for analog voltage
43	GND	Power ground
44	XR	Touch panel control pin
45	YU	Touch panel control pin
46	XL	Touch panel control pin
47	YD	Touch panel control pin
48	NC	No connect
49	NC	No connect
50	NC	No connect

## 4. Absolute Maximum Rating

Item	Symbol	MIN	MAX	Unit
Supply voltage for analog	V <sub>CC</sub>	-0.3	4.6	V
Supply voltage for logic	IOVCC	-0.3	4.6	V
Supply current (One LED)	I <sub>LED</sub>		30	mA
Operating temperature	T <sub>OP</sub>	-20	+70	°C
Storage temperature	T <sub>ST</sub>	-30	+80	°C

Note: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed

## 5. Electrical Characteristics

### 5.1 Input Power

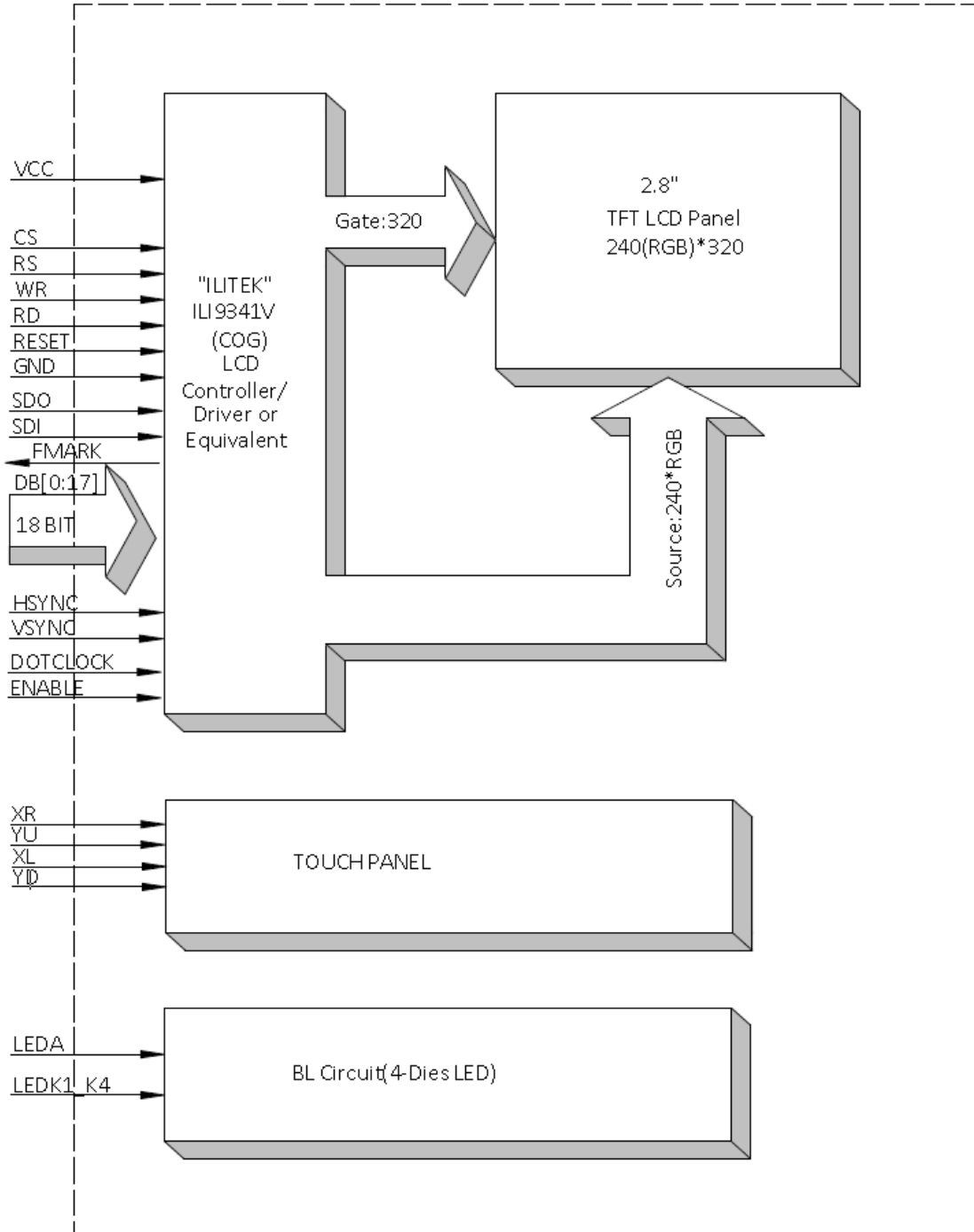
Item	Symbol	Min	Typ	Max	Unit	Applicable terminal
Supply Voltage for Analog	V <sub>CC</sub>	2.5	2.8	3.3	V	
Supply Voltage for Logic	IOVCC	1.65	1.8/2.8	3.3	V	
Input Voltage	V <sub>IL</sub>	GND	-	0.3IOVCC	V	
	V <sub>IH</sub>	0.8IOVCC	-	IOVCC		
Input leakage Current	I <sub>LKG</sub>	-1		1	uA	

### 5.2 Backlight Driving Conditions

Item	Symbol	Value			Unit	Remark
		Min	Typ	Max		
Voltage for LED Backlight	V <sub>F</sub>		3.2		V	I <sub>L</sub> =60mA
Current for LED Backlight	I <sub>L</sub>		60		mA	
Power Consumption	P		0.192		W	
LED Life Time		30,000			Hr	Note

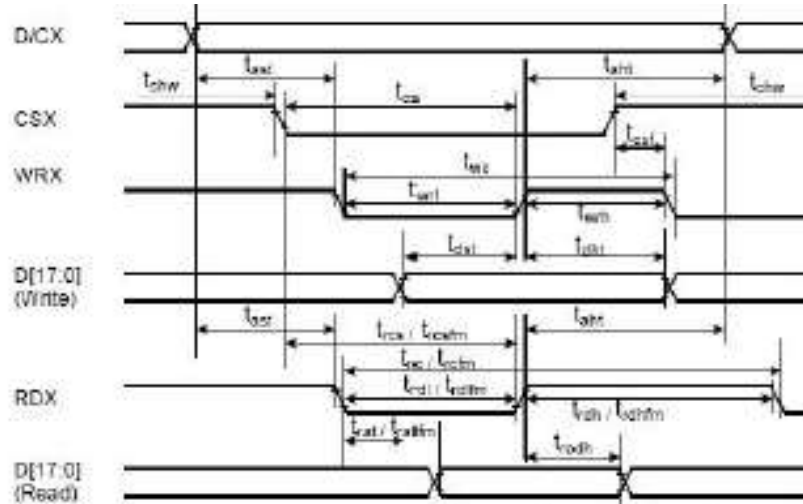
Note: Brightness to be decreased to 50% of the initial value at ambient temperature TA=25°C

### 5.3 Block Diagram



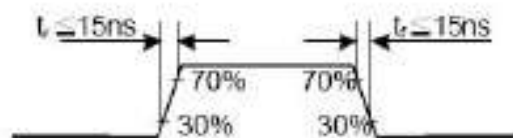
## 6. Interface Timing

### 6.1 MPU interface characteristic



Signal	Symbol	Parameter	min	max	Unit	Description
DCX	t <sub>ast</sub>	Address setup time	0	-	ns	
	t <sub>ahw</sub>	Address hold time (Writes/Read)	0	-	ns	
CSX	t <sub>chw</sub>	CSX 'H' pulse width	0	-	ns	
	t <sub>cs</sub>	Chip Select setup time (Write)	15	-	ns	
	t <sub>rcs</sub>	Chip Select setup time (Read ID)	45	-	ns	
	t <sub>rcsfm</sub>	Chip Select setup time (Read FM)	355	-	ns	
	t <sub>csf</sub>	Chip Select Wait time (Writes/Read)	10	-	ns	
WRX	t <sub>wc</sub>	Write cycle	65	-	ns	
	t <sub>wrh</sub>	Write Control pulse H duration	15	-	ns	
	t <sub>wrl</sub>	Write Control pulse L duration	15	-	ns	
RDX (FM)	t <sub>rcfm</sub>	Read Cycle (FM)	450	-	ns	
	t <sub>rdhfm</sub>	Read Control H duration (FM)	90	-	ns	
	t <sub>rdlfm</sub>	Read Control L duration (FM)	355	-	ns	
RDX (ID)	t <sub>rc</sub>	Read cycle (ID)	160	-	ns	
	t <sub>rdh</sub>	Read Control pulse H duration	90	-	ns	
	t <sub>rdl</sub>	Read Control pulse L duration	45	-	ns	
D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9]	t <sub>dst</sub>	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=9pF
	t <sub>dht</sub>	Write data hold time	10	-	ns	
	t <sub>rat</sub>	Read access time	-	40	ns	
	t <sub>ratm</sub>	Read access time	-	340	ns	
	t <sub>rod</sub>	Read output disable time	20	80	ns	

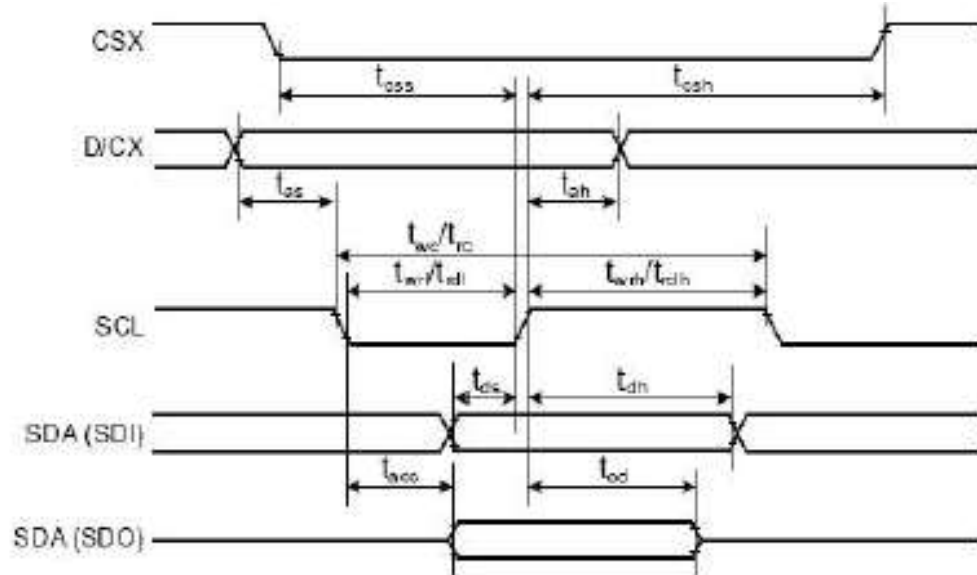
Note: Ta = -30 to 70 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, VSS=0V.





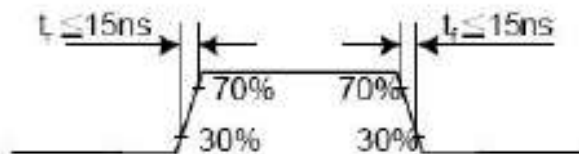


### 6.3 LINE SPI interface characteristic

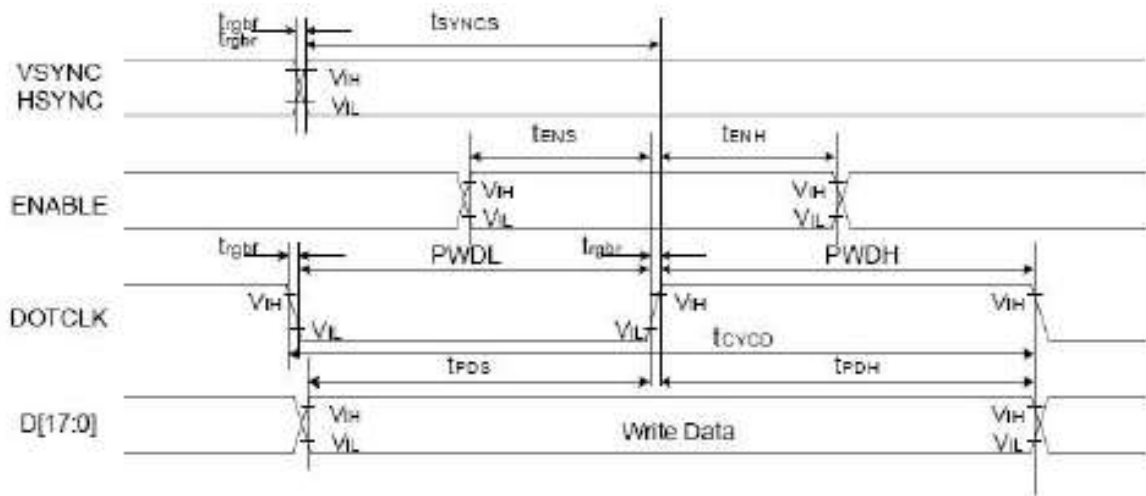


Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tcss	Chip select time (Write)	40	-	ns	
	tcsh	Chip select hold time (Read)	40	-	ns	
SCL	twc	Serial clock cycle (Write)	100	-	ns	
	twrh	SCL "H" pulse width (Write)	40	-	ns	
	twrl	SCL "L" pulse width (Write)	40	-	ns	
	trc	Serial clock cycle (Read)	150	-	ns	
	trdh	SCL "H" pulse width (Read)	60	-	ns	
	trdl	SCL "L" pulse width (Read)	60	-	ns	
D/CX	tas	D/CX setup time	10	-		
	tah	D/CX hold time (Write / Read)	10	-		
SDA / SDI (Input)	tds	Data setup time (Write)	30	-	ns	
	tdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	For maximum CL=30pF
	tod	Output disable time (Read)	10	50	ns	For minimum CL=8pF

Note: Ta = 25 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, AGND=VSS=0V

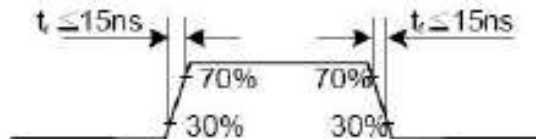


### 6.4 RGB interface characteristic



Signal	Symbol	Parameter	min	max	Unit	Description	
VSYNC / HSYNC	$t_{syncs}$	VSYNC/HSYNC setup time	15	-	ns	18/16-bit bus RGB interface mode	
	$t_{syncH}$	VSYNC/HSYNC hold time	15	-	ns		
DE	$t_{ens}$	DE setup time	15	-	ns		
	$t_{enH}$	DE hold time	15	-	ns		
D[17:0]	$t_{os}$	Data setup time	15	-	ns		
	$t_{oh}$	Data hold time	15	-	ns		
DOTCLK	PWDH	DOTCLK high-level period	15	-	ns		
	PWDL	DOTCLK low-level period	15	-	ns		
	$t_{cyco}$	DOTCLK cycle time	100	-	ns		
	$t_{r}, t_{f}$	DOTCLK, HSYNC, VSYNC rise/fall time	-	15	ns		
VSYNC / HSYNC	$t_{syncs}$	VSYNC/HSYNC setup time	15	-	ns		6-bit bus RGB interface mode
	$t_{syncH}$	VSYNC/HSYNC hold time	15	-	ns		
DE	$t_{os}$	DE setup time	15	-	ns		
	$t_{oh}$	DE hold time	15	-	ns		
D[17:0]	$t_{os}$	Data setup time	15	-	ns		
	$t_{oh}$	Data hold time	15	-	ns		
DOTCLK	PWDH	DOTCLK high-level pulse period	15	-	ns		
	PWDL	DOTCLK low-level pulse period	15	-	ns		
	$t_{cyco}$	DOTCLK cycle time	50	-	ns		
	$t_{r}, t_{f}$	DOTCLK, HSYNC, VSYNC rise/fall time	-	15	ns		

Note:  $T_a = -30$  to  $70$  °C,  $V_{DDI} = 1.65V$  to  $3.3V$ ,  $V_{CI} = 2.5V$  to  $3.3V$ ,  $AGND = VSS = 0V$



## 7. Optical Characteristics

ITEM	SYMBOL	CONDITIONS	SPECIFICATIONS			UNIT	NOTE
			MIN	TYP	MAX		
Luminance	L	IL=60mA		160		Cd/m <sup>2</sup>	
Contrast Ratio	CR	θ=0°		300			
Response Time	T <sub>ON</sub>	25°C		30		ms	
	T <sub>OFF</sub>						
CIE Color Coordinate	Red	X <sub>R</sub>	Viewing normal angle				
		Y <sub>R</sub>					
	Green	X <sub>G</sub>					
		Y <sub>G</sub>					
	Blue	X <sub>B</sub>					
		Y <sub>B</sub>					
White	X <sub>W</sub>	0.240	0.260	0.280			
	Y <sub>W</sub>	0.280	0.300	0.320			
Viewing Angle	Hor	θ <sub>x+</sub>		45		Degree	Gray Scale inversion
		θ <sub>x-</sub>		45			
	Ver	θ <sub>y+</sub>		45			
		θ <sub>y-</sub>		20			
Uniformity	Un		80		%		

### Note1. Definition of contrast ratio

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

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

For contrast ratio, Surface Luminance, Luminance uniformity and CIE, the testing data is based on TOPCON's BM-5 or BM-7 photo detector or compatible.

### Note2. Definition of surface luminance.

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

L<sub>v</sub> = Average Surface Luminance with all white pixels (P<sub>1</sub>, P<sub>2</sub>, P<sub>3</sub>, ..., P<sub>n</sub>)

### Note3. Definition of luminance uniformity

The luminance uniformity in surface luminance is determined by measuring luminance at each test position 1 through n, and then dividing the maximum luminance of n points luminance by minimum luminance of n points luminance. For more information see FIG.2.

$$YU = \frac{\text{Minimum surface luminance with all white pixels (P}_1, P_2, P_3, \dots, P_n)}{\text{Maximum surface luminance with all white pixels (P}_1, P_2, P_3, \dots, P_n)}$$

**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 ( $T_r$ ) 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%.

For additional information see FIG1.

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

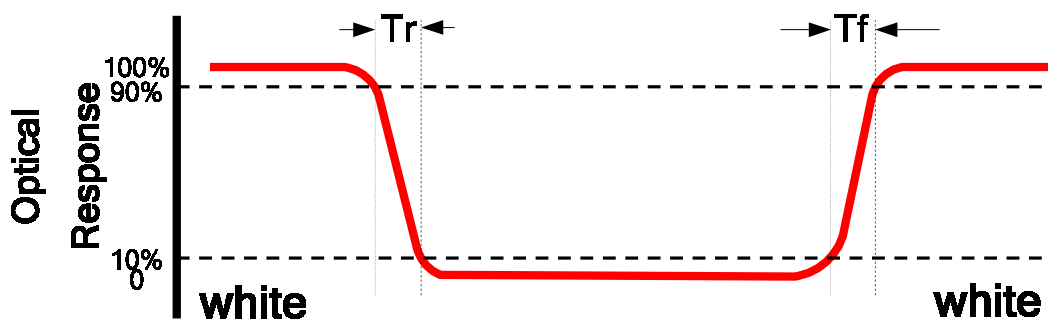
CIE (x,y) chromaticity, The x,y value is determined by screen active area center position P5. For more information see FIG.2.

**Note6. Definition of viewing angle**

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.

**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  $\phi = 5\text{mm}$  (BM-5) or  $\phi = 7.7\text{mm}$  (BM-7) 50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure a.

measurement instrument : TOPCON’s luminance meter BM-5 or BM-7 or compatible (see Figure c).

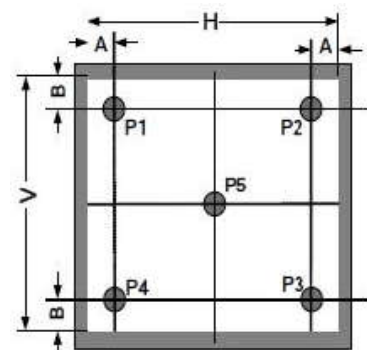


Figure a

Size : 5" < S ≤ 12.3" (see Figure b) H,V : Active area

Light spot size  $\phi=5\text{mm}$  (BM-5) or  $\phi=7.7\text{mm}$  (BM-7) 50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure b.

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

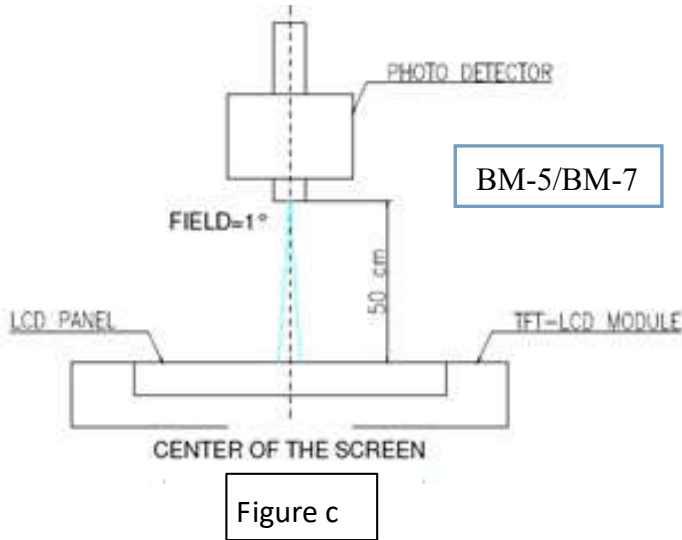
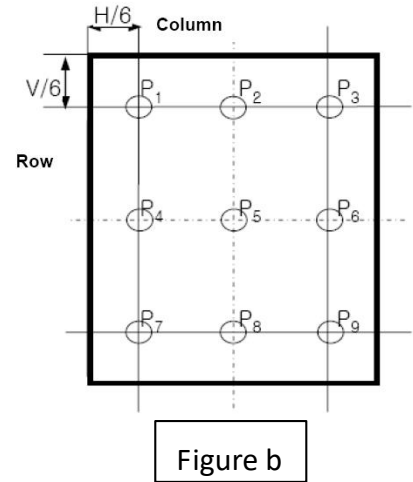
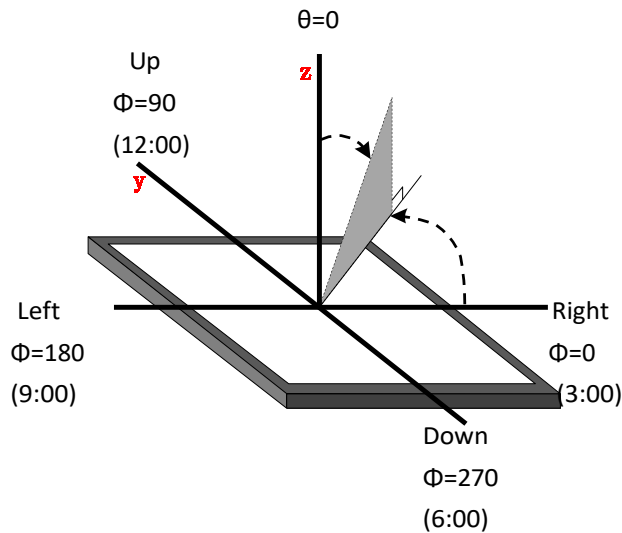


FIG.3.The definition of viewing angle

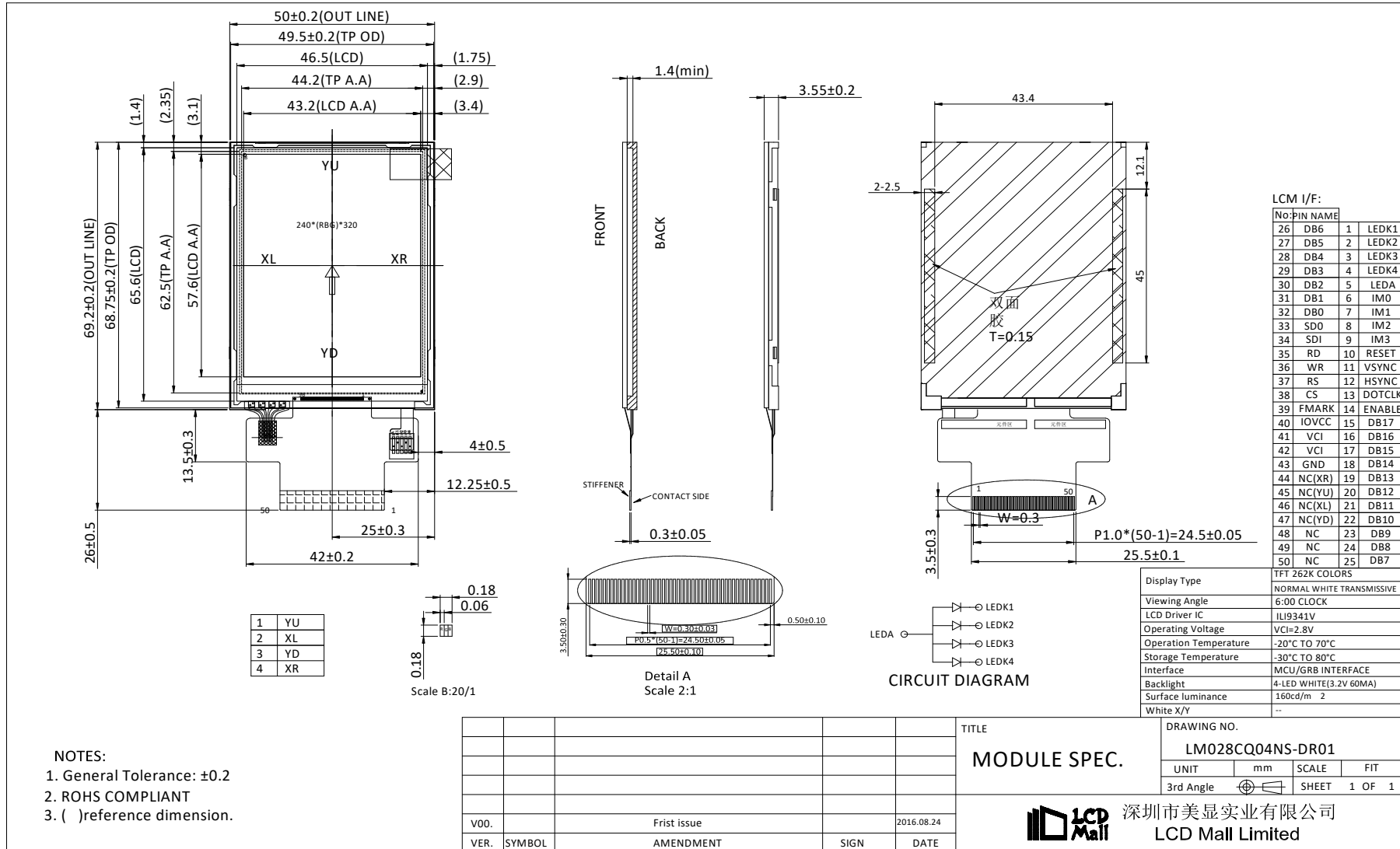


## 8. Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts= +70°C, 96hrs	Note 1 IEC60068-2-2, GB2423.2-89
2	Low Temperature Operation	Ta= -20°C, 96hrs	Note 2 IEC60068-2-1 GB2423.1-89
3	High Temperature Storage	Ta= +80°C, 120hrs	IEC60068-2-2 GB2423.2-89
4	Low Temperature Storage	Ta= -30°C, 120hrs	IEC60068-2-1 GB/T2423.1-89
5	High Temperature & Humidity Storage	Ta= +60°C, 90% RH max, 120 hours	IEC60068-2-3 GB/T2423.3-2006
6	Thermal Shock (Non-operation)	-20°C 30 min ~ +60°C 30 min Change time: 5min, 30 Cycle	Start with cold temperature, end with high temperature IEC60068-2-14, GB2423.22-87
7	Electro Static Discharge (Operation)	C=150pF, R=330 Ω, 5 points/panel Air:±8KV, 5 times; Contact: ±4KV, 5 times; (Environment: 15°C ~ 35°C, 30% ~ 60%, 86Kpa ~ 106Kpa)	IEC61000-4-2 GB/T17626.2-1998
8	Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke: 1mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X .Y. Z. (package condition)	IEC60068-2-6 GB/T2423.5-1995
9	Shock (Non-operation)	60G 6ms, ± X, ±Y, ± Z 3 times for each direction	IEC60068-2-27 GB/T2423.5-1995
10	Package Drop Test	Height: 80 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8-1995

- Note: 1. Ts is the temperature of panel's surface.  
2. Ta is the ambient temperature of sample.  
3. The size of sample is 5pcs.

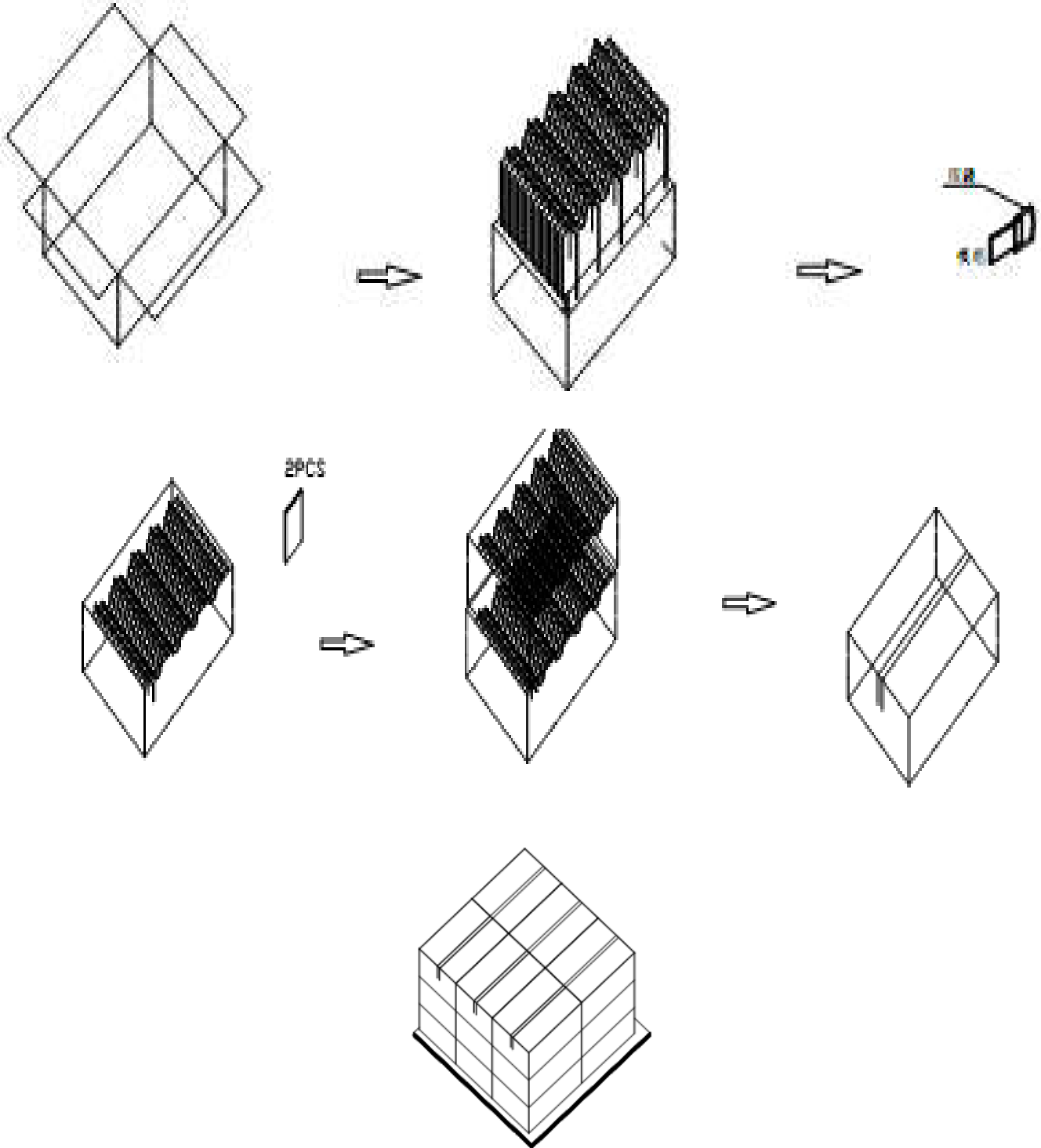
## 9. Mechanical Drawing





## 10. Packing

### Packing Method



## 11. TFT-LCD Module Inspection Criteria

### 11.1 Scope

The incoming inspection standards shall be applied to TFT –LCD Modules (hereinafter Called "Modules") that supplied by LCD Mall Limited.

### 11.2 Incoming Inspection

The customer shall inspect the modules within twenty calendar days of the delivery date (the inspection period) at its own cost. The result of the inspection (acceptance or rejection) shall be recorded in writing, and a copy of this writing will be promptly sent to The seller, If the results of the inspecting from buyer does not send to the seller within twenty Calendar days of the delivery date. The modules shall be regards as acceptance.

Should the customer fail to notify the seller within the inspection period, the buyers Right to reject the modules shall be lapsed and the modules shall be deemed to have Been accepted by the buyer

### 11.3 Inspection Sampling

- 3.1. Lot size: Quantity per shipment lot per model
  - 3.2. Sampling type: Normal inspection, Single sampling
  - 3.3. Inspection level: II
  - 3.4. Sampling table: MIL-STD-105E
  - 3.5. Acceptable quality level (AQL )
- Major defect: AQL=0.65 Minor defect: AQL=1.00

### 11.4 Inspection Conditions

#### 4.1 Ambient conditions:

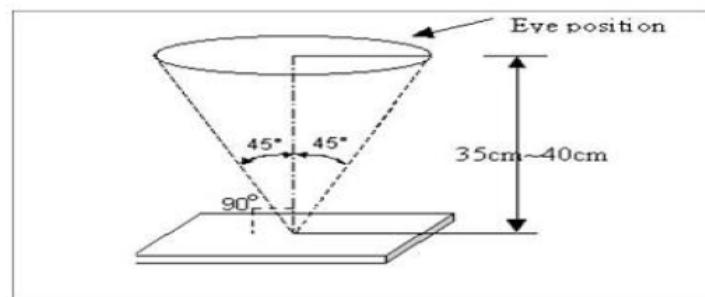
- a. Temperature: Room temperature  $25\pm 5^{\circ}\text{C}$
- b. Humidity:  $(60\pm 10)\% \text{RH}$
- c. Illumination: Single fluorescent lamp non-directive (300 to 700 Lux)

#### 4.2 Viewing distance

The distance between the LCD and the inspector's eyes shall be at least  $35\pm 5 \text{ cm}$ .

#### 4.3 Viewing Angle

U/D:  $45^{\circ}/45^{\circ}$ , L/R:



$45^{\circ}/45^{\circ}$

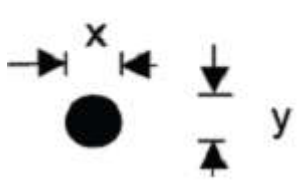
### 11.5 Inspection Criteria

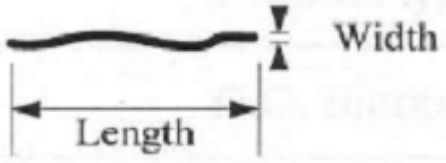

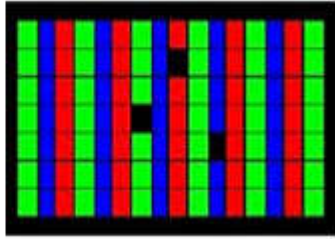
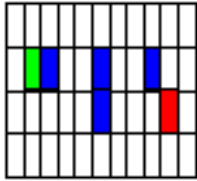
Defects are classified as major defects and minor defects according to the degree of Defectiveness defined herein.

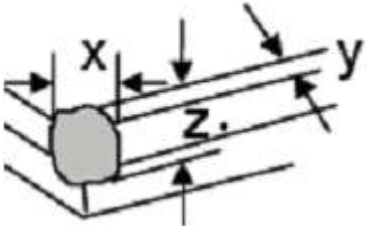
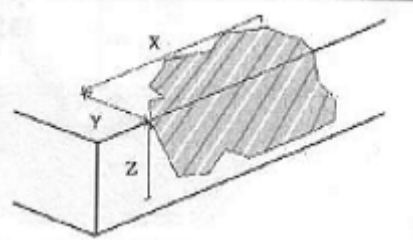
#### 11.5.1 Major defect

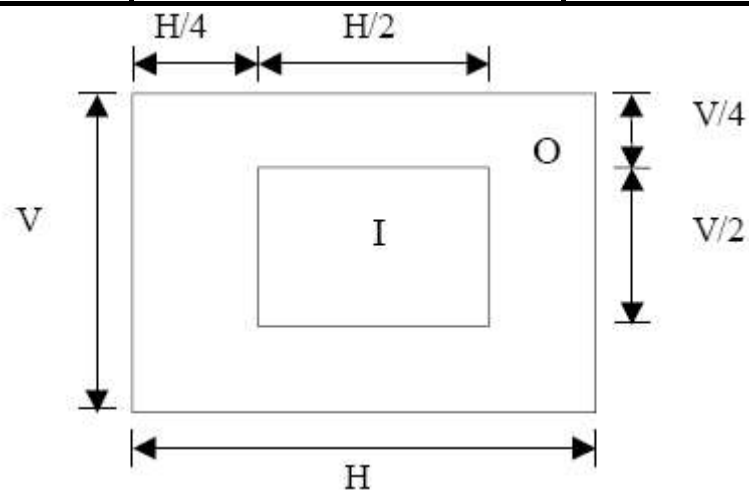
Item No	Items to be inspected	Inspection Standard
5.1.1	All functional defects	1) No display 2) Display abnormally 3) Short circuit 4) line defect
5.1.2	Missing	Missing function component
5.1.3	Crack	Glass Crack

#### 11.5.2 Minor defect

Item No	Items to be inspected	Inspection standard	
5.2.1	Spot Defect Including Black spot White spot Pinhole Foreign particle Polarizer dirt	For dark/white spot is defined $\phi = (x+y) / 2$ 	
		Size $\phi$ (mm)	Acceptable Quantity
		$\phi \leq 0.2$	Ignore
		$0.2 < \phi \leq 0.5$	3
		$0.5 < \phi$	Not allowed

5.2.2	Line Defect Including Black line White line Scratch	Define: 			
		Width(mm) Length(mm)		Acceptable Quantity	
		$W \leq 0.05$		Ignore	
		$0.05 < W \leq 0.1$ $L \leq 2.5$		3	
		$0.1 < W$ , or $L > 2.5$		Not allowed	
5.2.3	Polarizer Dent/Bubble	Size $\phi$ (mm)		Acceptable Quantity	
		$\phi \leq 0.2$		Ignore	
		$0.2 < \phi \leq 0.3$		2	
		$0.3 < \phi \leq 0.5$		1	
		$0.5 < \phi$		Not allowed	
		Total QTY		3	
5.2.4	Electrical Dot Defect	Bright and Black dot define:  and 			
		 Two Adjacent Dot			
		Inspection pattern: Full white、Full black、Red、green and blue screens			
		Item		Acceptable Quantity	
		Black dot defect		I	O
		2			

		Bright dot defect	1	(5mm≤Distance)
		Two Adjacent Dot	1	
		There or more Adjacent Dot	Not allowed	
		Total Dot	2	
5.2.5	Glass defect	 <p>1. Corner Fragment:</p>		
		Size(mm)	Acceptable Quantity	
		X≤3mm Y≤1mm Z≤T	Ignore T: Glass thickness X: Length Y: Width Z: thickness	
		 <p>2. Side Fragment:</p>		
		Size(mm)	Acceptable Quantity	
X≤5.0mm Y ≤1mm Z≤T	T: Glass thickness X: Length Y: Width Z: thickness			





## I area & O area

- Note:
- 1). Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.
  - 2). The distance between two bright dot defects (red, green, blue, and white) should be larger than 15mm.
  - 3). The distance between black dot defects or black and bright dot defects should be more than 5mm apart.
  - 4). Polarizer bubble is defined as the bubble appears on active display area. The defect of polarizer bubble shall be ignored if the polarizer bubble appears on the outside of active display area.

### 11.6 Mechanics specification

As for the outside dimension, weight of the modules, please refer to product specification  
For more details



## 12. Precautions for Use of LCD modules

### 12.1 Handling Precautions

12.1.1. The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

12.1.2. If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

12.1.3. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

12.1.4. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

12.1.5. If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

Isopropyl alcohol & Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following: Water & Ketene & Aromatic solvents

12.1.6. Do not attempt to disassemble the LCD Module.

12.1.7. If the logic circuit power is off, do not apply the input signals.

12.1.8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

12.1.8.1. Be sure to ground the body when handling the LCD Modules.

12.1.8.2. Tools required for assembly, such as soldering irons, must be properly ground.

12.1.8.3. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

12.1.8.4. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

### 12.2 Storage Precautions

12.2.1. When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

12.2.2. The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0°C ~ 40°C Relatively humidity: ≤80%

12.2.3. The LCD modules should be stored in the room without acid, alkali and harmful gas.

### 12.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.