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PRODUCT SPECIFICATION
FOR LCD MODULE

Revision: <u>V0</u>

Model No: <u>FXD020Q06FPC-A3</u>

Module Type: <u>COG+FPC+B/L</u>

APPROVED SIGNATURE

Approved Product Specification only
Approved Product Specification and Samples

Prepared By	Checked By	Approved By

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Contents

1. General Description

FXD020Q06FPC-A3 is a transmissive type a-Si TFT-LCD (amorphous silicon thin film transistor liquid crystal display) module, which is composed of a TFT-LCD panel, a driver circuit and a backlight unit. The panel size is 2.0 inch and the resolution is 240*320, the panel can display up to 262K colors. The LCM can be easily accessed by 4-SPI interface.

2. Physical   Features

Display Mode	TFT-LCD Module
	Active matrix TFT, Transmissive type
Display Format	Graphic 240ˆ RGBˆ 320 Dot-matrix
Input Data	The Data input by 4-SPI interface
Viewing Direction	6 O'CLOCK (Human Eye)
Drive	ST7789V

3. Mechanical Specification

Item	Contents	Unit
Module size (WˆHˆT)	36.20ˆ 51.80ˆ 2.45	mm
Number of dots	240(RGB) ˆ 320	---
Active area (WˆH)	30.60ˆ 40.80	mm

4. Outline Dimension

5. Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Remark
Power Voltage	VCC	-0.3	4.6	V	
Input Voltage	VIN	-0.3	VCC+0.3	V	
Operating temperature	TOPR	-10	60		
Storage temperature	TSTR	-20	60		
Humidity	---	---	90	%RH	---

If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

6. Electrical Characteristics

Item		Symbol	Rating			Unit	Remark
			Min	Typ	Max		
Power Voltage	Logic	VCC	2.5	2.8	3.3	V	Note1
Input Voltage	L level	VIL	VSS	---	0.3IOVCC	V	IOVCC= 1.65-3.3V
	H level	VIH	0.7IOVCC	---	IOVCC	V	
LCD Drive Power current		ILCD	---	5	---	mA	---

Remark:
   Note1:Vcom must be adjusted to optimize display quality: Cross-talk, Contrast Ratio and etc.

7. Module Function Description

7-1. Block Diagram Of LCM

```
          ┌──────────────────────────┐        ┌──────────┐
  ====>   │    2.0Î ˙ H-LCHD          │        │          │
          │    240*320 Dots          │        │  Back    │
          └──────────────────────────┘        │  Light   │
                        ▲                      │          │
          ┌──────────────────────────┐        │          │
          │        ┌──────────────┐   │        └──────────┘
          │        │ Soure  Driver│   │              ▲
          │        └──────────────┘   │              │
          │ ┌──────────────┐          │              │
          │ │ Gate Driver  │          │              │
          │ └──────────────┘          │              │
          │                           │              │
          │        ST7789V            │              │
          └───────────▲───────────────┘              │
                      │                               │
          ┌──────────────────────────┐               │
          │  D = B %Å Å Å Å 10= B     │───────────────┘
          │       Interface          │
          └──────────────────────────┘
```
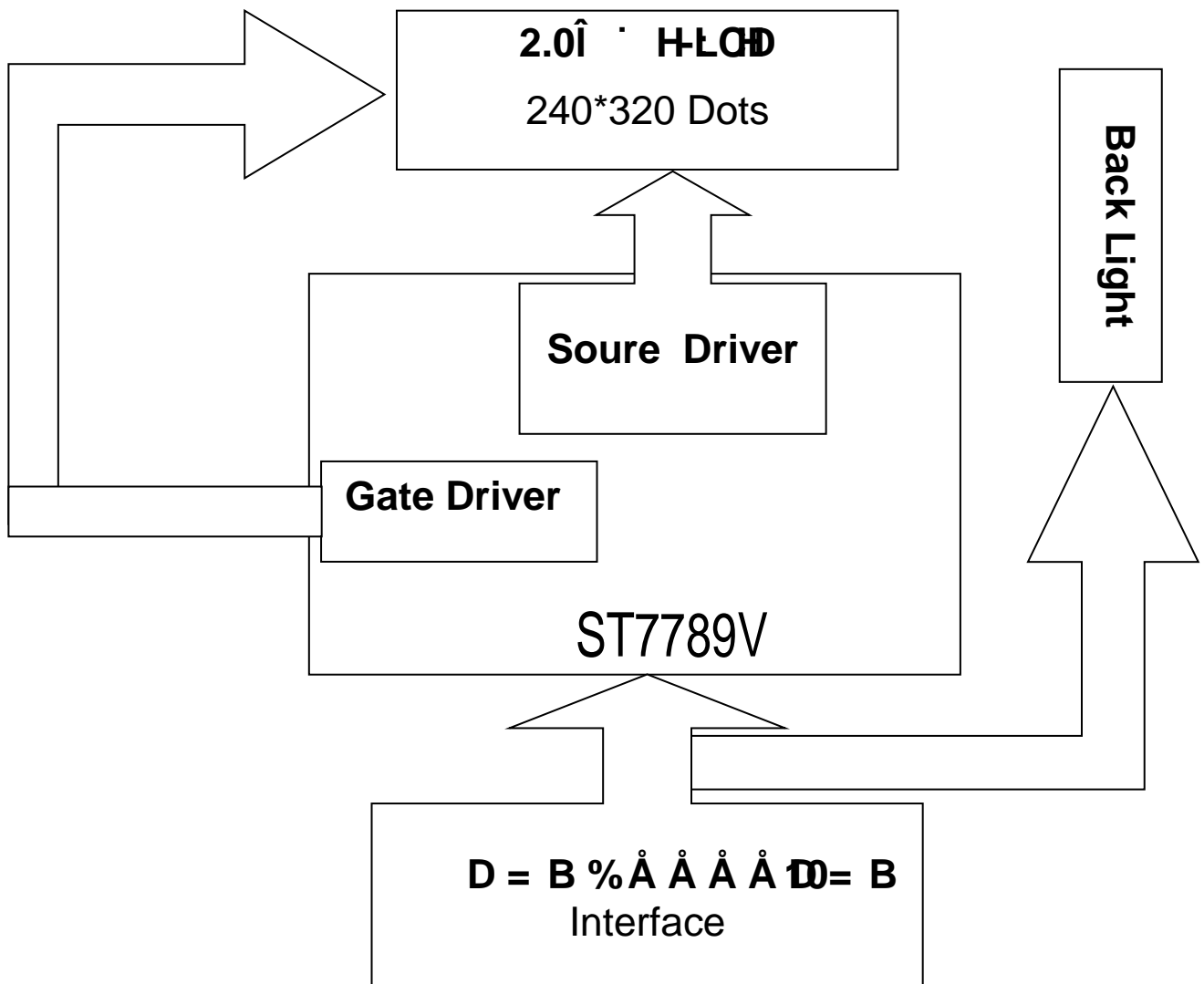
7-2. Pin Description

PIN NO.	Symbol	I/O	Description
1	GND	P	Ground
2	RS	I	Command and Data select pin
3	CS	I	Chip select pin
4	SCL	I	Serial clock pin
5	DATA	I/O	Serial data input/output PIN
6	RESET	I	Reset pin.
7	VDD	P	power supply
8	VSS	P	Ground
9	LED+	BL POWER SUPPLY	Anode pin of backlight
10	LED-	BL POWER SUPPLY	Cathode pin of backlight

7-3. Timing Characteristics

7.3.1

4-Wire Serial Peripheral Interface Protocol

NCS can be "H" between Command and parameter
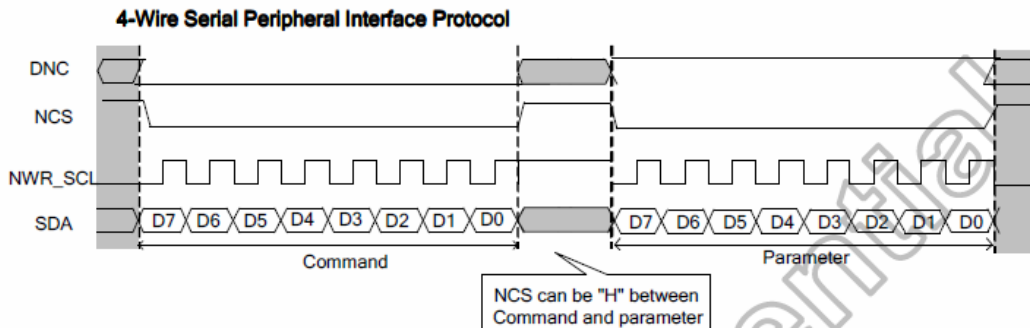
Figure 4-29: Index register write timing in 4-wire serial bus system interface

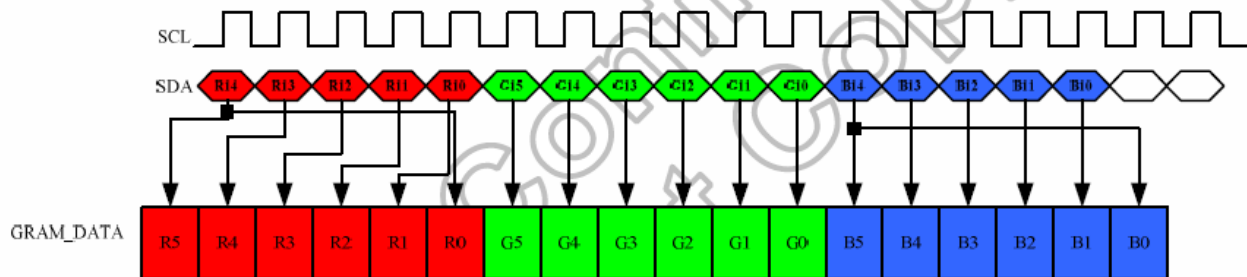**16-bit Data Transfer Timing Format in 4-wire Serial Bus Interface for GRAM write (Index 17h= 05)**

18-bit Data Transfer Timing Format in 4-wire Serial Bus Interface for GRAM write (Index 17h= 06)
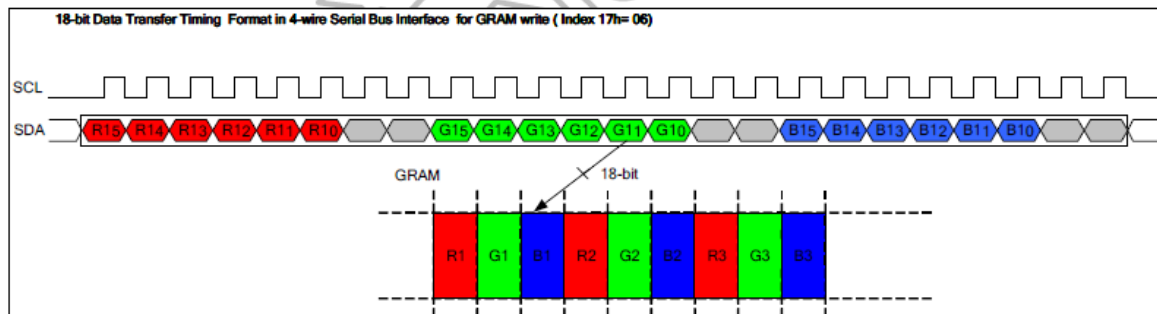
Figure 4-30: Data write timing in 4-wire serial bus system interface
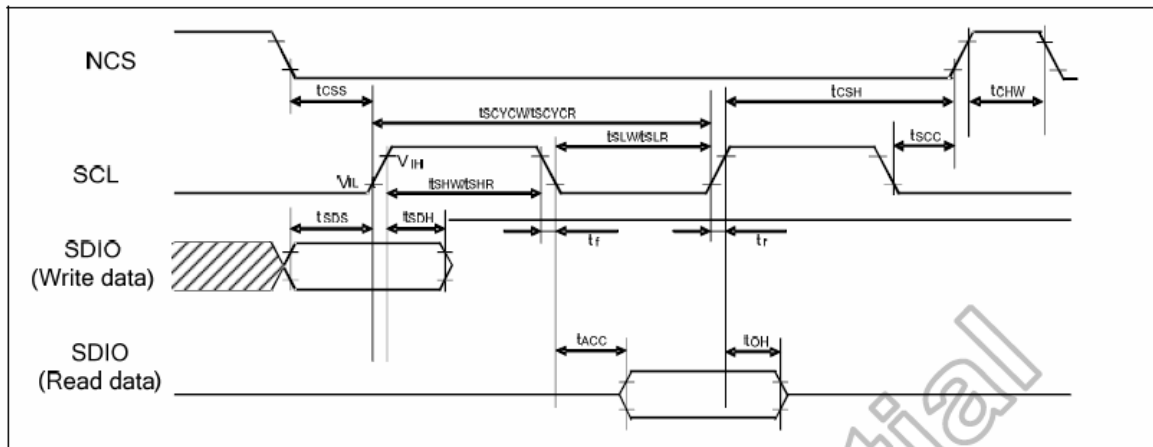
Figure 8-4: Serial interface characteristics

(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.3V to 3.3V, T$_A$=-30 to 70°C)

| Parameter	Symbol	Conditions	Spec. Min.	Spec. Typ.	Spec. Max.	Unit
Serial clock cycle (Write)	tSCYCW		14	-	-	
SCL "H" pulse width (Write)	tSHW	SCL	6	-	-	ns
SCL "L" pulse width (Write)	tSLW		6	-	-	
Data setup time (Write)	tSDS	SDA	6	-	-	ns
Data hold time (Write)	tSDH		6	-	-	
Serial clock cycle (Read)	tSCYCR		150	-	-	
SCL "H" pulse width (Read)	tSHR	SCL	60	-	-	ns
SCL "L" pulse width (Read)	tSLR		60	-	-	
Access Time	tACC	SDI for maximum CL=30pF For minimum CL=8pF	10	-	50	ns
Output disable time	tOH	SDO For maximum CL=30pF For minimum CL=8pF	15	-	50	ns
SCL to Chip select	tSCC	SCL, NCS	20	-	-	ns
NCS "H" pulse width	tCHW	NCS	40	-	-	ns
Chip select setup time	tCSS	NCS	15	-	-	ns
Chip select hold time	tCSH		15	-	-	

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Input Signal Slope

V$_{IH}$=0.7*IOVCC
V$_{IL}$=0.3*IOVCC
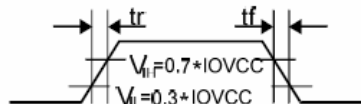
Output Signal Slope

V$_{OH}$=0.8*IOVCC
V$_{OL}$=0.2*IOVCC

9
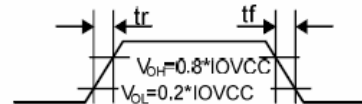
8. Backlight Characteristics

Item	Symbol	Min	Typ	Max	Unit	Condition	Remark
Forward voltage	V_{BL}	2.9	3.1	3.3	V		-
Current	I_{BL}	-	60	-	mA	IF=60mA	-
ICE	X	0.21	-	0.36	-		-
	Y	0.21	-	0.36	-		
Brightness of LCM	-	350	400		cd/m²		★1
Uniformity	-	80	-	-	%		★2

★1 Test condition is：

    (a) Center point on active area

    (b) Best Contrast

★2 Uniform measure condition：

    (1)Measure 9 point. Measure location is show below：

    (2)Uniform = (Min. brightness / Max. brightness)×100%

    (3)Best Contrast.

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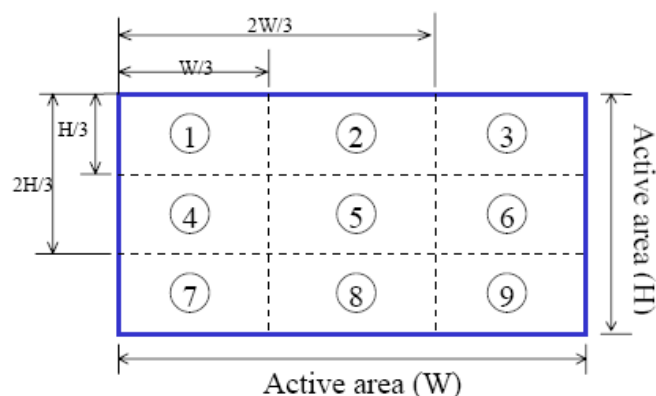
9. Electro-Optical Characteristics

Item		Symbol	Specifications			Unit	Note
			Min.	Typ.	Max.		
Transmittance（Without Polarizer）*		T%	-	11.5	-	%	*[1]Here the data are design value. [2]Chromaticity measuring machine: CFT-01. **Reference Only**
Contrast ratio*		Cr (Θ=0°)	150	300	-		
Response time (25℃)*		$T_r + T_f$	-	25	50	ms	
Gray scale inversion direction (Cr≥ 10)*		Θ21	35	45	-	deg	
		Θ22	15	25	-		
		Θ12	35	45	-		
		Θ11	35	45	-		
Chromaticity of CF	Red	x	0.610	0.630	0.650		
		y	0.311	0.331	0.351		
		Y	17.0	22.0	27.0		
	Green	x	0.290	0.310	0.330		
		y	0.534	0.554	0.574		
		Y	60.9	65.9	70.9		
	Blue	x	0.128	0.148	0.168		
		y	0.149	0.169	0.189		
		Y	16.3	21.3	26.3		
	White	x		0.313			
		y		0.351			
		Y		36.4			
Color gamut of CF (NTSC%)		S		50.4		%	

[1] Transmittance (T%)

The transmittance of the panel including polarizers is measured without electrical driving.
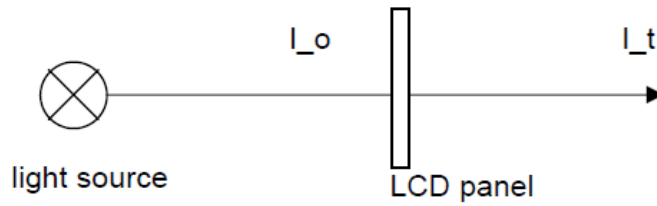
The Transmittance is defined as:

$$Tr = \frac{I\_t}{I\_o} \times 100\%$$

here,

I_o: the brightness of the light source.

I_t : the brightness after panel transmission.

[2] Response Time(Tr、Tf)

The rise time 'Tr' is defined as the time for luminance to change from 90% to 10% as a result of a change of the electrical condition. The fall time 'Tf' is defined as the time for luminance to change from 10% to 90% as a result of a change of the electrical condition.

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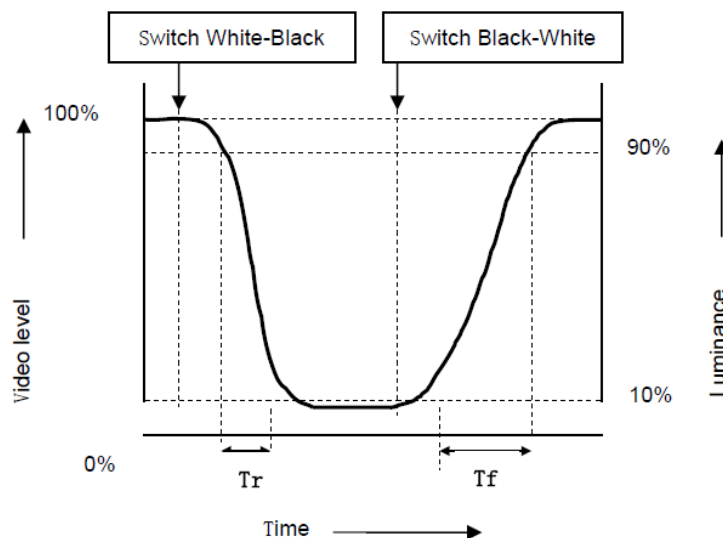
[3] Contrast ratio (Cr)
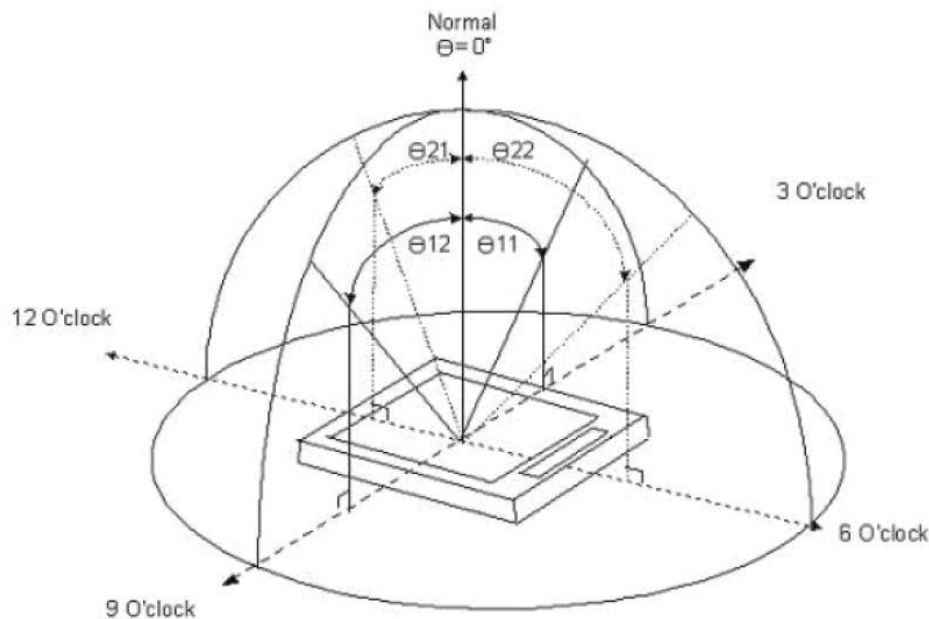
The contrast ratio (Cr), measured on a module, is the ratio between the luminance (L_w) in a full white area (R=G=B=1) and the luminance (L_d) in a dark area (R=G=B=0):

$$Cr = \frac{L\_w}{L\_d}$$

[4]Viewing angle diagram

[5] Definition of color gamut

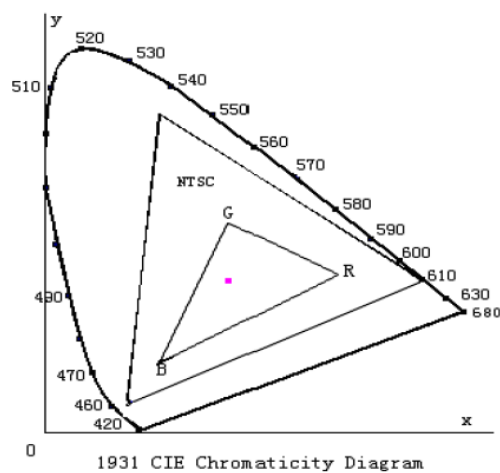**Measuring machine:CFT-01. NTSC'S Primaries: R(x,y,Y)、 G(x,y,Y)、 B(x,y,Y).**

1931 CIE Chromaticity Diagram

Fig. 1931 CIE chromaticity diagram

Color gamut: $S = \dfrac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$

10. Reliability

10. 1. MTBF

The LCD module shall be designed to meet a minimum MTBF value of 50000 hours with normal. (25°C in the room without sunlight)

10. 2. Test condition

ITEM	CONDITIONS	CRITERION
OPERATING TEMPERATURE	HIGH TEMPERTURE+60 48HRS	NO DEFECT IN DISPLAYING AND OPERATIONAL FUNCTION
	LOW TEMPERTURE-10 48HRS	
STORAGE TEMPERATURE	HIGH TEMPERTURE+60 48HRS	NO DEFECT IN DISPLAYING AND OPERATIONAL FUNCTION
	LOW TEMPERTURE-20 48HRS	
HUMIDITY	40 90%RH 48HRS	NO DEFECT IN DISPLAYING AND OPERATIONAL FUNCTION

Note　The need to restore at room temperature for 2 hours after the test

11. Inspection Standards

1. AQL(Acceptable Quality Level)
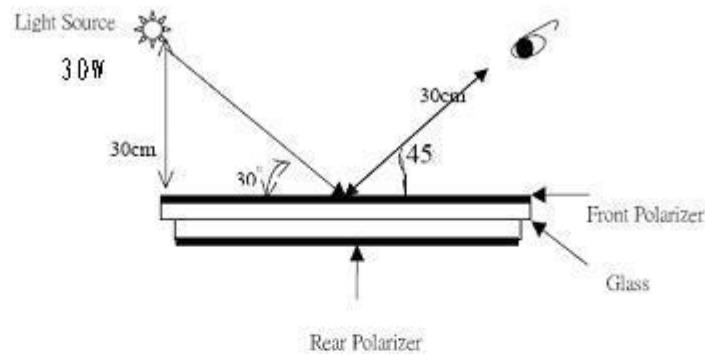   AQL of major and minor defect

According to GB/T 2828-2003 ; , normal inspection, Class

MAJOR DEFECT	MINORDEFECT
0.65	1.5

2. Basic conditions for inspection

The LCM face to us, in normal environment, About an angle of incidence 30, a distance of 30cm with normal eye,with an angle of 45 degree to check the products without uncovering the film!
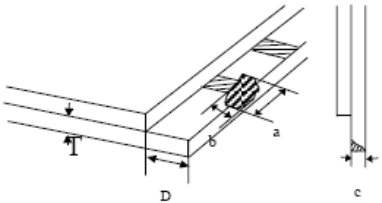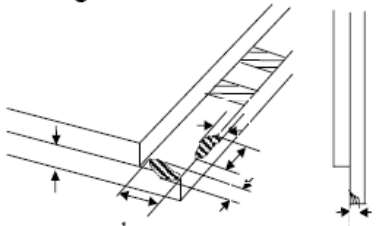
(As shown below)

3. Inspection item and criteria

3.1 Visual inspection criterion in immobility

3.1.1 Glass defect

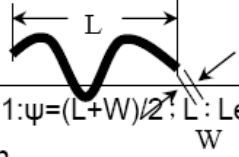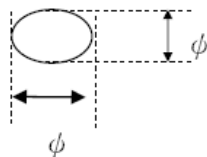| No	Defect item	Criteria	Remark
1	Dimension Unconformity (Major defect)	By Engineering Drawing	
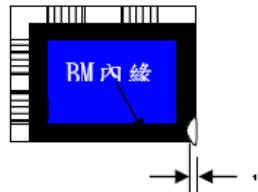
No	Defect item	Criteria	Remark
2	Cracks (Major defect)	1.Linear cracks on panel 【Reject】 2. Nonlinear crack contrast by limited sample	
3	Glass extrude the conductive area (minor defect)	a: disregards and no influence assemblage 1) b≤1/3Pin width(non bonding area) 【Accept】 2) bonding area≤0.5mm 【Accept】	a:Length, b:Width
4	Pin-side，conductive area damaged (minor defect)	(a c：disregards) b≤ 1/3 of effective length for bonding electrode 【Accept】	a：Length，b：Width，c：Thickness
5	Pin-side，non-conductive area damaged (minor defect)	1) Damage area don't touch the ITO (Inclueling contraposition mark,except scribing mark) 【Accept】 2) c<T b≤BM 1/3 of width 【Accept】 3) c=T b not touch the seal glue 【Accept】 4) a disregards	a：Length，b：Width，c：Thickness

No	Defect item	Criteria	Remark
6	Non-pin-side damage (minor defect)	c<T 1) b exceeds 1/3 BM 【Reject】 c=T b not touch the seal glue 【Reject】	c : Thickness b: width of damage RM 內綫

3.1.2 LCD appearance defect (View area)

No	Defect item	Criteria		Remark
1	Fiber、glass cratch、polarizer scratch/folded (minor defect)	Specification	Allowable	note1: L：Length，W：Width note2: disregard if out of AA
		0.05mm<W≦0.1mm; L≦3.0mm	1	
		W>0.1mm ; L>3.0mm	0	
2	Polarizer bubble、concave and convex (minor defect)	ψ≦0.2mm	disregard	note 1:ψ=(L+W)/2 ; L：Length，W：Width note2: disregard if out of AA
		0.2mm<ψ ≦ 0.3mm	2	
		0.3mm<ψ ≦ 0.5mm	1	
		0.5mm<ψ	0	
3	Black dots、dirty dots、impurities、eyewinker (Major defect)	ψ≦0.15mm	disregard	note2: disregard if out of AA
		0.15mm<ψ ≦ 0.25mm	2	
		0.25mm<ψ ≦ 0.3mm	1	
		0.3mm<ψ	0	
4	Polarizer prick (Major defect)	ψ≦0.1mm	disregard	note1:ψ=(L+W)/2 ; L= Length，W=Width note2: the distance between two dots ＞5mm
		0.1mm<ψ≦0.25mm	3	
		ψ＞0.25mm	0	

3.1.3 .FPC

No	Defect item	Criteria			Remark
1	Copper screen peel (Major defect)	Copper screen peel 【Reject】			
2	No release tape or peel (Major defect)	No release tape or peel 【Reject】			
3	Dirty dot and impurity of FPC for customer using side (minor defect)	Specification	Allowable		note1: Cannot have stride ITO impurities
		ψ≦0.25mm	2		
		ψ>0.25	0		

3.1.4 Black tape & Mara tape

	Defect item	Criteria	Remark
1	FPC or H/S black tape shift (minor defect)	1.shift spec: 1)glue to the polarize 【Reject】 2) IC bare 【Reject】 2. left-and-right spec: 1) exceed of FPC edge or H-S edge 【Reject】 2)IC bare 【Reject】	
2	No black tape (Major defect)	No black tape 【Reject】	
3	Tape position mistake (minor defect)	Not by engineering drawing 【Reject】	
4	Mara tape defect (minor defect)	Peel before pulling the protecting film. 【Reject】	

3.1.5 Silicon and Tuffy glue

No	Defect item	Criteria	Remark
1	Quantity of silicon (minor defect)	Uncover the ITO and circuit area. 【Reject】	note: compared by engineering drawing.

No	Defect item	Criteria	Remark
2	Tuffy glue (minor defect)	1. Uncover the reveal copper area 【Reject】 2. Cover layer 0.3mm(Min) ~ 3.0mm(Max) 【accept】	note:if customer has special requirement , refer to the technical document.
	Depth of glue covering	Depth of glue covering	Except from the special