

# 恆穰企業股份有限公司

## PRODUCT SPECIFICATION

**3.2" 240RGB x 400 TFT**

**MODEL NUMBER: sample PL3201051A0-A**

**Rev: 0**

PENGLEI	PREPARED BY	CHECKED BY	APPROVED BY
SIGNATURE			
DATE			

CUSTOMER APPROVAL	SIGNATURE	DATE

## Revision History

Revision	Date	Originator	Detail	Remarks
1	2012-09-10		First Release	

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## 1. General Description

This display module is a transmissive type color active matrix TFT(Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This module is composed of a TFT LCD module, a driver circuit, and a back-light unit.

The resolution of a 2.8" contains 240 (RGB)X320 dots and can display up to 262k colors.

## 2. Module Parameter

Features	Details	Unit
Display Size(Diagonal)	3. 2"	-
LCD type	$\alpha$ -Si TFT	-
Display Mode	TN/ Normally white	-
Resolution	240 RGB x400	-
View Direction	12 O'clock	Best image
Grayscale Inversion Direction	6 O'clock	-
Module Outline	47.5(H) ×80.8(V)×3.55 (T)	mm
TP Outline	47.3(H) ×77.9 (V)	mm
TP Viewing Area	43.16(H) ×74.35 (V)	
TP Active Area	42.96(H) ×73.55 (V)	
Active Area	41.76 (H)×69.6(V)	mm
Viewing Area	N/A	
Pixel Size	-----	mm
Pixel Arrangement	Stripe	-
Display Colors	NORMAL WHITE	-
Interface	MCU 8bit/16bit interface	-
Driver IC	HX8352/B	-
Operating Temperature	-20~70	°C
Storage Temperature	-30~80	°C
Weight	TBD	g

## 3. Absolute Maximum Ratings

$V_{SS}=0V$ ,  $T_a=25^{\circ}C$

Item		Symbol	Min.	Max.	Unit
Supply Voltage	Power supply	VCC	-0.3	+4.6	V
	Analog	VCI	-	-	V
	IO	IOVCC	-	-	V
Input Voltage		$V_i$	-0.3	IOVCC+0.3	V
Storage temperature		$T_{stg}$	-30	+80	°C
Operating temperature		$T_{op}$	-20	+70	°C
Storage humidity		$H_{stg}$	10	Note 1	%RH
Operating humidity		$H_{op}$	10	Note 1	%RH

Note 1: 90%RH max, If  $T_a$  is below  $50^{\circ}C$ ; 60%RH max, If  $T_a$  is over  $60^{\circ}C$ .

#### 4. DC Characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	Power supply	VCC	2.5	2.8	3.3	V
	Analog	VCI	2.5	2.8	3.3	V
	IO	IOVCC	1.65	2.8	3.3	V
Logic Low input voltage		$V_{IL}$	0.0	-	0.2*IOVCC	V
Logic High input voltage		$V_{IH}$	0.7*IOVCC	-	IOVCC	V
Logic Low output voltage		$V_{OL}$	-	-	0.2*IOVCC	V
Logic High output voltage		$V_{OH}$	0.8*IOVCC	-	IOVCC	V
Current Consumption	Normal display	Ivdd	-	-	-	mA
	Standby mode	Ivdd-	-	-	-	uA
Frame Frequency		$f_{FR}$	-	TBD	-	Hz

#### 5. Backlight Characteristics

##### 5.1. Backlight Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	$V_f$	Ta=25 °C, I <sub>F</sub> =80mA		3.2	3.5	V/LED
Forward Current	$I_f$	Ta=25 °C, V <sub>F</sub> =3.2V	-	80	-	mA
Luminance	$L_v$	-	3000	3500	4300	cd / m <sup>2</sup>
Uniformity	Avg	-	80	-	-	%
CIE	X	-	0.26	-	0.3	-
	Y	-	0.26	-	0.3	-
Power dissipation	$P_d$	-	-	-	-	mW
Backlight Driving Voltage	V <sub>AK</sub>	-	-	3.2	-	V
Drive method	Constant current					
LED Configuration	6 White LEDs in parallel					

**Note:** Test condition I<sub>f</sub>=80mA, Ta=25°C.

## 6. Optical Characteristics

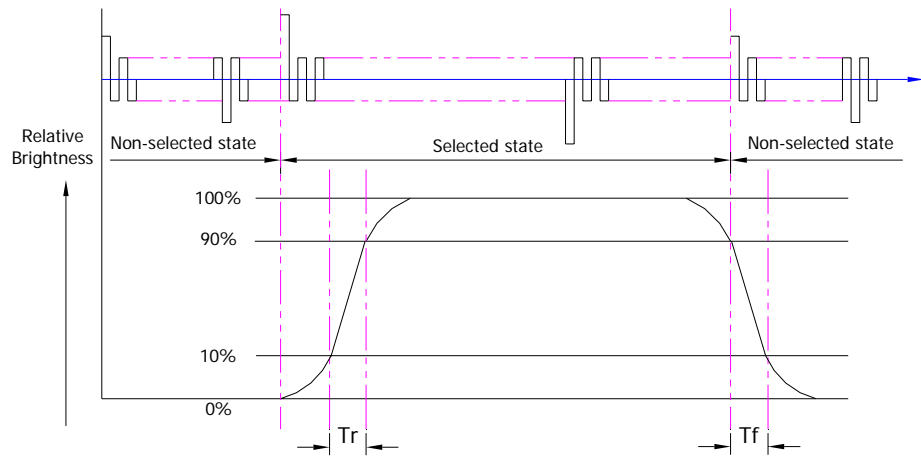
### 6.1. Optical Characteristics

Ta=25°C, VDD=2.8V, TN LC+ Polarizer

Backlight On (Transmissive Mode)	Item		Symbol	Condition	Specification			Unit
					Min.	Typ.	Max.	
	Luminance on TP surface( $I_f$ =60mA)		$L_V$	Normally viewing angle	-	-TBD	-	cd/m <sup>2</sup>
	Contrast ratio(See 6.3)		$CR$	$\theta_x = \theta_y = 0^{\circ}$	-	300	-	-
	Response time (See 6.2)		$T_{R+T_F}$		-	10	20	ms
	Chromaticity Transmissive (See 6.5)	Red	$X_R$	-	-	TBD	-	-
			$Y_R$		-	TBD	-	-
		Green	$X_G$		-	TBD	-	-
			$Y_G$		-	TBD	-	-
		Blue	$X_B$		-	TBD	-	-
$Y_B$			-		TBD	-	-	
White		$X_W$	-		TBD	-	-	
		$Y_W$	-		TBD	-	-	
Viewing Angle (See 6.4)	Horizontal	$\theta_{x+}$	Center CR≥10	-	45	-	Deg.	
		$\theta_{x-}$		-	45	-		
	Vertical	$\theta_{y+}$		-	35	-		
		$\theta_{y-}$		-	15	-		
	NTSC Ratio(Gamut)		-	-		TBD	-	%

## 6.2. Definition of Response Time

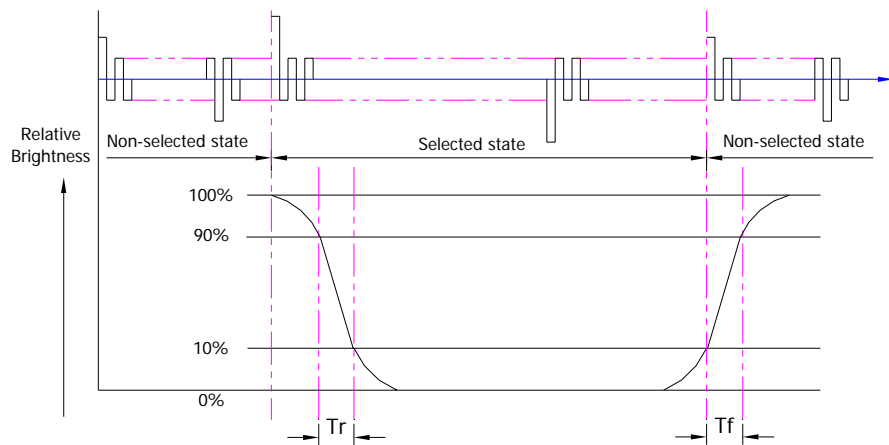
### 6.2.1. Normally Black Type (Negative)



$T_r$  is the time it takes to change from non-selected state with relative luminance 10% to selected state with relative luminance 90%;

$T_f$  is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

### 6.2.2. Normally White Type (Positive)



$T_r$  is the time it takes to change from non-selected state with relative luminance 90% to selected state with relative luminance 10%;

$T_f$  is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

### 6.3. Definition of Contrast Ratio

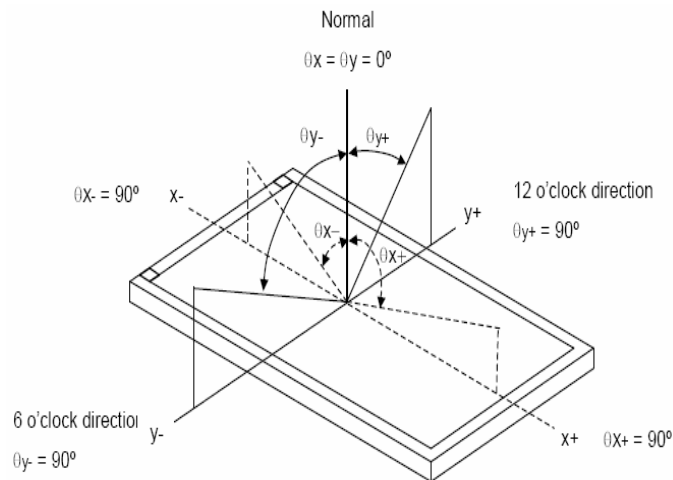
Contrast is measured perpendicular to display surface in reflective and transmissive mode.

The measurement condition is:

Measuring Equipment	BM-7 or EQUI
Measuring Point Diameter	3mm//1mm
Measuring Point Location	Active Area centre point
Test pattern	A: All Pixels white
	B: All Pixel black
Contrast setting	Maximum

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel

### 6.4. Definition of Viewing Angles



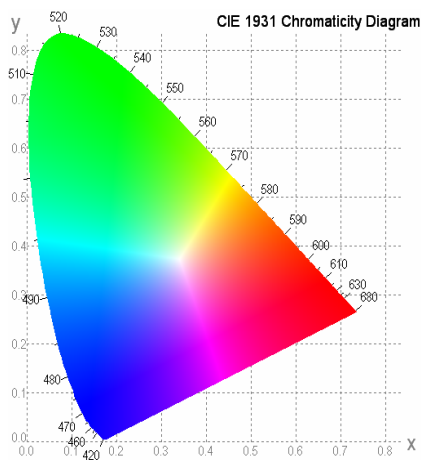
Measuring machine: LCD-5100 or EQUI

### 6.5. Definition of Color Appearance

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)





## 6.6. Definition of Surface Luminance, Uniformity and Transmittance

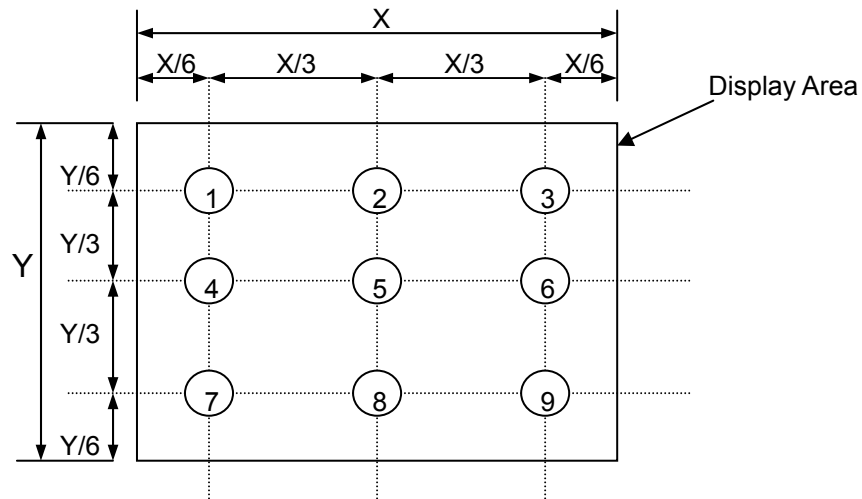
Using the transmissive mode measurement approach, measure the white screen luminance of the display panel and backlight.

6.6.1. Surface Luminance:  $L_V = \text{average } (L_{P1}:L_{P9})$

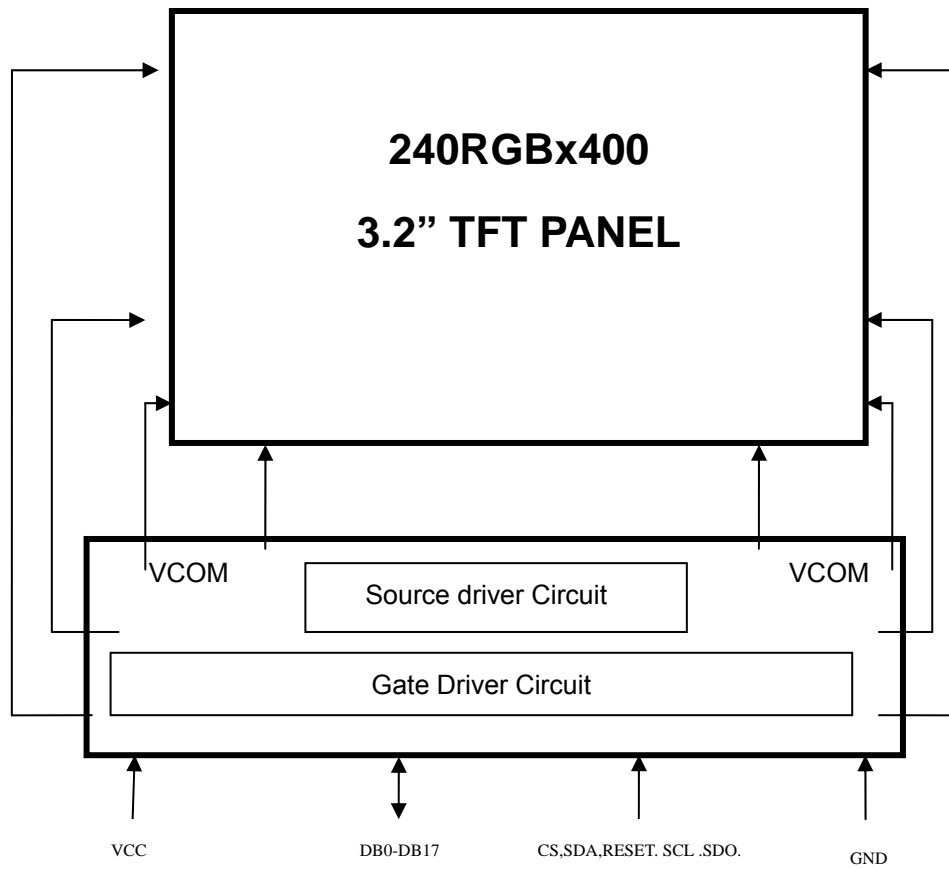
6.6.2. Uniformity =  $\text{Minimal } (L_{P1}:L_{P9}) / \text{Maximal } (L_{P1}:L_{P9}) * 100\%$

6.6.3. Transmittance =  $L_V \text{ on LCD} / L_V \text{ on Backlight} * 100\%$

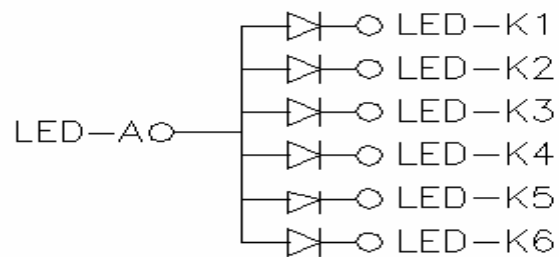
Note : Measuring machine: BM-7



## 7. Block Diagram and Power Supply



### 1. LED CIRCUIT DIAGRAM :



## 8. Interface Pins Definition

### 8.1. Module interface

No.	Symbol	I/O	DESCRIPTION
1	GND	P	GROUND
2	XR	I	Touch panel interface
3	YD	I	Touch panel interface
4	XL	I	Touch panel interface
5	YU	I	Touch panel interface
6	GND	P	GROUND
7	VCC	P	POWER SUPPLY
8	IOVCC	P	Power supply for IO port
9	GND	P	GROUND
10	RD	I	LCD Read for the MPU interface
11	WR	I	Write control pin for the MPU interface
12	RS	I	Com LCD Read for the MPU interface
13	CS	I	Chip selection
14	FMARK	I	Synchronies MCU to frame rate
15^30	DB0^DB15	I	Data bus
31	RESET	I	LCM reset signal
32	IM0	I	Data interface select
33	LEDA	I	LED ANODE
34^39	LEDK1^LEDK6	P	LED CATHODE K1^K6
40	GND	P	GROUND

## **9. AC Characteristics**

### **9.1. Reset timing**

Please refer to IC datasheet.

### **9.2. interface timing**

#### **9.2.1. 8bit/16bit interface timing requirement 1**

Please refer to IC datasheet

## **10. Command Table**

Please refer to IC datasheet.

## 11. Recommended Setting and Initialization Flow for Reference.

TBD.

## 12. Quality Assurance

### 12.1. Purpose

This standard for Quality Assurance assures the quality of LCD module products supplied to customer by Penglei display.

### 12.2. Agreement Items

Penglei and customer shall negotiate if the following situation occurs:

12.4.1 Discrepancies between Penglei's QA standards and customer's QA standards.

12.4.2 Additional requirement to be added in product specification.

12.4.3 Any other special problem.

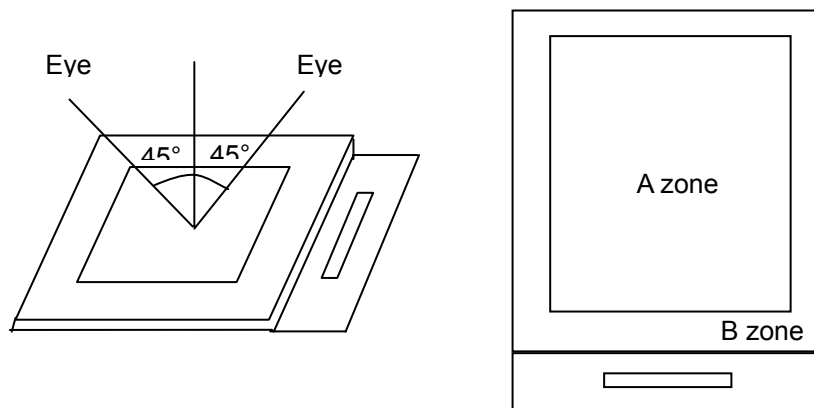
### 12.3. Standard of the Product Visual Inspection

12.3.1 Appearance inspection:

12.3.1.1 The inspection must be under illumination about 1000 – 1500 lx, and the distance of view must be at 30cm  $\pm$  2cm.

12.3.1.2 The viewing angle should be 45° from the vertical line without reflection light or follows customer's viewing angle specifications.

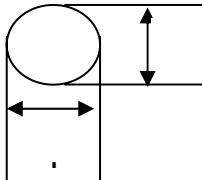
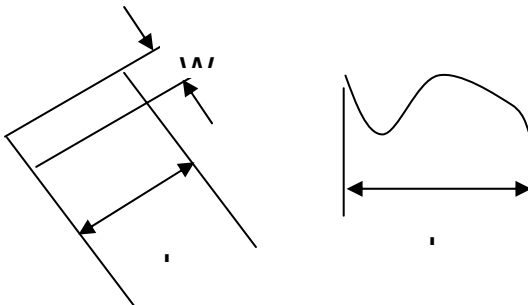
12.3.1.3 Definition of area: A Zone: Active Area, B Zone: Viewing Area,

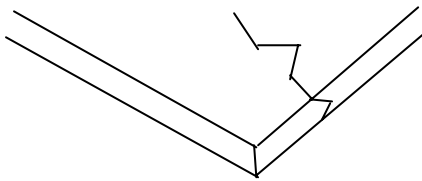


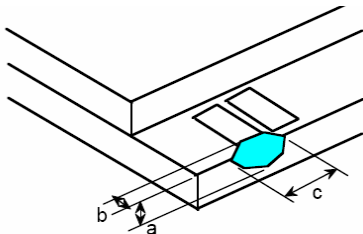
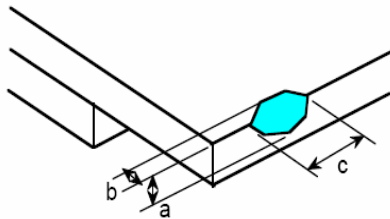
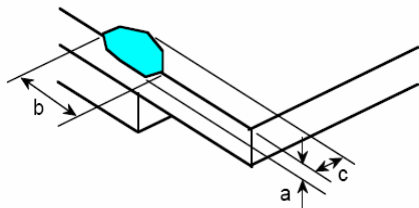
12.3.2 Basic principle:

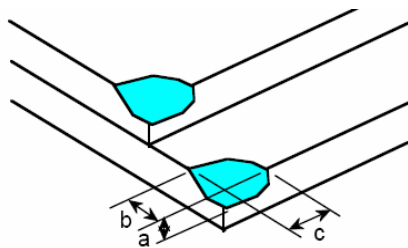
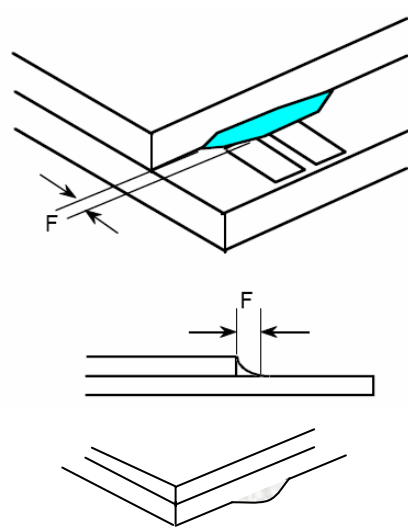
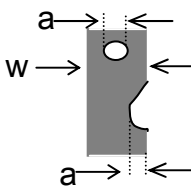
12.3.2.1 A set of sample to indicate the limit of acceptable quality level must be discussed by both Penglei and customer when there is any dispute happened.

#### 12.4. Inspection Specification

No.	Item	Criteria (Unit: mm)																		
01	Black / White spot Foreign material (Round type) Pinholes Stain Particles inside cell. (Minor defect)	 $\phi = (a + b) / 2$ <table border="1"> <thead> <tr> <th>Size</th><th>Area</th><th>Acc. Qty</th></tr> </thead> <tbody> <tr> <td><math>\phi \leq 0.10</math></td><td></td><td>Ignore</td></tr> <tr> <td><math>0.10 &lt; \phi \leq 0.20</math></td><td></td><td>2</td></tr> <tr> <td><math>0.20 &lt; \phi \leq 0.25</math></td><td></td><td>1</td></tr> <tr> <td><math>0.25 &lt; \phi</math></td><td></td><td>0</td></tr> <tr> <td>Total</td><td></td><td>2 no include <math>\phi \leq 0.10</math></td></tr> </tbody> </table> <p>Distance between 2 defects should more than 3mm apart.</p>	Size	Area	Acc. Qty	$\phi \leq 0.10$		Ignore	$0.10 < \phi \leq 0.20$		2	$0.20 < \phi \leq 0.25$		1	$0.25 < \phi$		0	Total		2 no include $\phi \leq 0.10$
Size	Area	Acc. Qty																		
$\phi \leq 0.10$		Ignore																		
$0.10 < \phi \leq 0.20$		2																		
$0.20 < \phi \leq 0.25$		1																		
$0.25 < \phi$		0																		
Total		2 no include $\phi \leq 0.10$																		
02	Black and White line Scratch Foreign material (Line type) (Minor defect)	 <table border="1"> <thead> <tr> <th>Length</th><th>Width</th><th>Acc. Qty</th></tr> </thead> <tbody> <tr> <td>/</td><td><math>W \leq 0.03</math></td><td>Ignore</td></tr> <tr> <td><math>L \leq 2</math></td><td><math>0.03 &lt; W \leq 0.05</math></td><td>1</td></tr> <tr> <td>/</td><td><math>0.05 &lt; W</math></td><td>0</td></tr> <tr> <td colspan="2">Total</td><td>1</td></tr> </tbody> </table> <p>Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.</p>	Length	Width	Acc. Qty	/	$W \leq 0.03$	Ignore	$L \leq 2$	$0.03 < W \leq 0.05$	1	/	$0.05 < W$	0	Total		1			
Length	Width	Acc. Qty																		
/	$W \leq 0.03$	Ignore																		
$L \leq 2$	$0.03 < W \leq 0.05$	1																		
/	$0.05 < W$	0																		
Total		1																		

03	Glass Crack (Minor defect)	 <p>LCD with extensible crack line is unacceptable(When press the cracked LCD area, the line will expand, we define it is extensible crack line)</p>
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04	<p>Glass Chipping Pad Area: (Minor defect)</p> 	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td><math>c &lt; 5.0, b &lt; 0.4</math></td><td>Ignore</td></tr><tr><td colspan="2"><math>a &lt; \text{Glass Thickness}</math></td></tr></table>	Length and Width	Acc. Qty	$c < 5.0, b < 0.4$	Ignore	$a < \text{Glass Thickness}$					
Length and Width	Acc. Qty											
$c < 5.0, b < 0.4$	Ignore											
$a < \text{Glass Thickness}$												
05	<p>Glass Chipping Rear of Pad Area: (Minor defect)</p> 	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td><math>c &gt; 3.0, b &lt; 1.0</math></td><td>1</td></tr><tr><td><math>c &lt; 3.0, b &lt; 1.0</math></td><td>2</td></tr><tr><td><math>c &lt; 3.0, b &lt; 0.5</math></td><td>4</td></tr><tr><td colspan="2"><math>a &lt; \text{Glass Thickness}</math></td></tr></table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	2	$c < 3.0, b < 0.5$	4	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty											
$c > 3.0, b < 1.0$	1											
$c < 3.0, b < 1.0$	2											
$c < 3.0, b < 0.5$	4											
$a < \text{Glass Thickness}$												
06	<p>Glass Chipping Except Pad Area: (Minor defect)</p> 	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td><math>c \leq 0.6, b &lt; 5.0</math></td><td>Ignore</td></tr><tr><td colspan="2"><math>a &lt; \text{Glass Thickness}</math></td></tr></table>	Length and Width	Acc. Qty	$c \leq 0.6, b < 5.0$	Ignore	$a < \text{Glass Thickness}$					
Length and Width	Acc. Qty											
$c \leq 0.6, b < 5.0$	Ignore											
$a < \text{Glass Thickness}$												

07	<p>Glass Corner Chipping: (Minor defect)</p> 	<table> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> <tr> <td><math>c &lt; 2.0, b &lt; 1.5</math></td> <td>Ignore</td> </tr> <tr> <td><math>c &lt; 1.5, b &lt; 2</math></td> <td>Ignore</td> </tr> <tr> <td colspan="2"><math>a &lt; \text{Glass Thickness}</math></td> </tr> </table>	Length and Width	Acc. Qty	$c < 2.0, b < 1.5$	Ignore	$c < 1.5, b < 2$	Ignore	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty									
$c < 2.0, b < 1.5$	Ignore									
$c < 1.5, b < 2$	Ignore									
$a < \text{Glass Thickness}$										
08	<p>Glass Burr: (Minor defect)</p> 	<table> <tr> <th>Length</th> <th>Acc. Qty</th> </tr> <tr> <td><math>F &lt; 0.5</math></td> <td>Ignore</td> </tr> </table> <p>Glass burr don't affect assemble and module dimension.</p>	Length	Acc. Qty	$F < 0.5$	Ignore				
Length	Acc. Qty									
$F < 0.5$	Ignore									
09	<p>FPC Defect: (Minor defect)</p> 	<p>9.1 Dent, pinhole width <math>a &lt; w/3</math>. (w: circuitry width.)</p> <p>9.2 Open circuit is unacceptable.</p> <p>9.3 No oxidation, contamination and distortion.</p>								



10	Bubble on Polarizer (Minor defect)	<table><tr><td>Diameter</td><td>Acc. Qty</td></tr><tr><td><math>\varphi \leq 0.20</math></td><td>Ignore</td></tr><tr><td><math>0.20 &lt; \varphi \leq 0.30</math></td><td>2</td></tr><tr><td><math>0.30 &lt; \varphi</math></td><td>None</td></tr></table>	Diameter	Acc. Qty	$\varphi \leq 0.20$	Ignore	$0.20 < \varphi \leq 0.30$	2	$0.30 < \varphi$	None
Diameter	Acc. Qty									
$\varphi \leq 0.20$	Ignore									
$0.20 < \varphi \leq 0.30$	2									
$0.30 < \varphi$	None									
11	Dent on Polarizer (Minor defect)	<table><tr><td>Diameter</td><td>Acc. Qty</td></tr><tr><td><math>\varphi \leq 0.20</math></td><td>Ignore</td></tr><tr><td><math>0.20 &lt; \varphi \leq 0.30</math></td><td>2</td></tr><tr><td><math>0.30 &lt; \varphi</math></td><td>None</td></tr></table>	Diameter	Acc. Qty	$\varphi \leq 0.20$	Ignore	$0.20 < \varphi \leq 0.30$	2	$0.30 < \varphi$	None
Diameter	Acc. Qty									
$\varphi \leq 0.20$	Ignore									
$0.20 < \varphi \leq 0.30$	2									
$0.30 < \varphi$	None									
12	Bezel	12.1 No rust, distortion on the Bezel. 12.2 No visible fingerprints, stains or other contamination.								
13	Touch Panel	D: Diameter   W: width   L: length 13.1 Spot: $D \leq 0.20$ is acceptable $0.20 < D \leq 0.3$ , acceptable QTY, 3 2dots are acceptable and the distance between defects should more than 10 mm. $D > 0.3$ is unacceptable 13.2 Dent: $D > 0.30$ is unacceptable 13.3 Scratch: $W \leq 0.03$ , $L \leq 10$ is acceptable, $0.03 < W \leq 0.10$ , $L \leq 10$ ,acceptable QTY, 3 Distance between 2 defects should more than 10 mm. $W > 0.10$ is unacceptable.								
14	PCB	14.1 No distortion or contamination on PCB terminals. 14.2 All components on PCB must same as documented on the BOM/component layout. 14.3 Follow IPC-A-600F.								
15	Soldering	Follow IPC-A-610C standard								
16	Electrical Defect (Major defect)	The below defects must be rejected. 16.1 Missing vertical / horizontal segment, 16.2 Abnormal Display. 16.3 No function or no display. 16.4 Current exceeds product specifications. 16.5 LCD viewing angle defect. 16.6 No Backlight.								

		<p>16.7 Dark Backlight.</p> <p>16.8 Touch Panel no function.</p> <p>16.9 Dark Dot –one Allowed.</p> <p>16.10 Bright Dot – one Allowed.</p> <p>Remark:</p> <p>1. A pixel defect is acceptable if one color is none functional and causes a bright dot. The display may have one case where one color is out and cause a dark dot.</p> <p>2. Bright dot caused by scratch and foreign object accords to item 1.</p>
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Remark: Visual and cosmetic defects are rejectable only if these fall within the LCD viewing area.

#### **12.5. Classification of Defects**

12.5.1 Visual defects (Except no / wrong label) are treated as minor defect and electrical defect is major.

12.5.2 Two minor defects are equal to one major in lot sampling inspection.

#### **12.6. Identification/marketing criteria**

Any unit with illegible / wrong /double or no marking/ label shall be rejected.

#### **12.7. Packing**

12.7.1 There should be no damage of the outside carton box, each packaging box should has label in the correct location per packing drawing requirement.

12.7.2 All direct package materials shall offer ESD protection.

### 13. Reliability Specification

Item	Condition	Cycle Time	Quantity	Remark
Constant Temp. and Constant Humidity Operation Test	+40 ± 3°C, 90 ± 3%RH	120hrs	--	*1
High Temp. Operation Test	+70 ± 3°C	120hrs	--	
Low Temp. Operation Test	-20 ± 3°C	120hrs	--	
Thermal Shock Test	-20 ± 3°C (30min) +70 ± 3°C (30min)	10cycles	--	
ESD Test(end product)	150pF, 330Ω, ±2KV, Contact	10times	--	*2, *3
	150pF, 330Ω, ±6KV, Air			
Vibration Test (for packaging)	Frequency: 10Hz to 55Hz to 10Hz, Swing:1.5mm,time : X,Y,Z each 2H.	6hrs	One inner carton	*4

Note 1. For humidity test, DI water should be used.

Inspection Standard: Inspect after 1-2hrs storage at room temperature, the sample shall be free from the following defects:

- Air bubble in the LCD
- Seal Leakage
- Non-display
- Missing Segment
- Glass Crack
- IDD is greater than twice initial value.
- Others as per QA Inspection Criteria

Note 2. No defect is allowed after testing

The End Product ESD value is only indicative and depends on customer ESD protection design for the whole system

Note 3. ESD should be applied to LCD glass panel, not other areas (such as on IC and so on)  
IDD should be within twice initial value.

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.

Note 4. Only upon request.

## **14. Precautions and Warranty**

### **14.1. Safety**

- 14.1.1 The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.
- 14.1.2 Since the liquid crystal cells are made of glass, do not apply strong impact on them. Handle with care.

### **14.2. Handling**

- 14.2.1 Reverse and use within ratings in order to keep performance and prevent damage.
- 14.2.2 Do not wipe the polarizer with dry cloth, as it might cause scratch. If the surface of the LCD needs to be cleaned, wipe it swiftly with cotton or other soft cloth soaked with petroleum IPA, do not use other chemicals.

### **14.3. Operation**

- 14.3.1 Do not drive LCD with DC voltage
- 14.3.2 Response time will increase below lower temperature
- 14.3.3 Display may change color with different temperature
- 14.3.4 Mechanical disturbance during operation, such as pressing on the display area, may cause the segments to appear “fractured”.

### **14.4. Static Electricity**

- 14.4.1 CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by ground human body, etc.
- 14.4.2 The normal static prevention measures should be observed for work clothes and benches.
- 14.4.3 The module should be kept into anti-static bags or other containers resistant to static for storage.

### **14.5. Limited Warranty**

- 14.5.1 Unless otherwise agreed between Penglei and customer, Penglei will replace or repair any of its LCD and LCM which Penglei found to be defective electrically and visually when inspected in accordance with Penglei Quality Standards, for a period of one year from date of shipment.
- 14.5.2 The warranty liability of Penglei is limited to repair and/or replacement. Penglei will not be responsible for any consequential loss.
- 14.5.3 If possible, we suggest you use up all modules in six months. If the module storage time over twelve months, we suggest that recheck it before the module be used.

### Reference

Item	Description	Revision
HX8352/B	IC Data sheet	V01
PL3201051A0-A	LCM assembly drawing	R0