

# ZETTLER DISPLAYS

## SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

CUSTOMER APPROVAL			
※ PART NO. : <u>ATM0240B32A (ZETTLER DISPLAYS) VER1.0</u>			
APPROVAL		COMPANY CHOP	
CUSTOMER COMMENTS			

ZETTLER DISPLAYS ENGINEERING APPROVAL		
DESIGNED BY	CHECKED BY	APPROVED BY
ZZK		

**REVISION RECORD**

REVISION	REVISION DATE	PAGE	CONTENTS
VER1.0	2024-8-8	--	FIRST ISSUED

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## 1. General specification

Item	Specification	Remark
1. LCD size	2.4 inch(Diagonal)	
2. Driver element	a-Si TFT active matrix	
3. Resolution	240x(RGB)x320	
4. Display mode	Normally Black, IPS, Transmissive	
5. Dot Pitch (W*H)	0.045mm(W) x 0.135mm(H)	
6. Pixel pitch(W*H)	0.135mm(W) x 0.135mm(H)	
7. Active Area(W*H)	36.72mm(W) x 48.96mm(H)	
8. Module size (W*H)	42.72mm(W) x 60.26(H) x2.2mm(D)	Note 1
9. Surface treatment	Anti-glare	
10. Color arrangement	RGB-stripe	
11. Color	65K	
12. Viewing angle (L/R/T/B)	80/80/80/80	
13. Interface	SPI	
14. LCD controller	ST7789T3	
15. LCM brightness	350 cd/m2 Typ.	
16. Backlight driving condition	80mA @3.2V	
17. Touch panel	N.A.	
18. Touch controller	N.A.	
19. Operation temperature	-20~60 °C	
20. Weight	8.4g(Typ.)	
21. RoHS	RoHS compliant	

**Note 1:** Please refer to mechanical drawing.



### 3. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Power Supply LCD voltage 1	VCC-VSS	-0.3	+4.6	V
Power Supply LCD voltage 3	VGH-VGL	-0.3	+30.0	V
Supply current (One LED)	I <sub>LED</sub>	--	25	mA
Operating temperature	T <sub>OP</sub>	-20	+60	°C
Storage temperature	T <sub>ST</sub>	-30	+70	°C

### 4. Electrical characteristics

Item	Symbol	Min	Typ	Max	Unit	Applicable terminal
	VCC	+2.4	+2.8	+3.3	V	
	VGH	+12.2	/	+14.97	V	
	VGL	-12.5	/	-7.16	V	
Logic Low level Input voltage	V <sub>IL</sub>	VSS	--	0.3IOVCC	V	
Logic High level Input voltage	V <sub>IH</sub>	0.7IOVCC	--	IOVCC	V	
Logic Low level output voltage	V <sub>oL</sub>	VSS	--	0.2IOVCC	V	
Logic High level output voltage	V <sub>oH</sub>	0.8IOVCC	--	IOVCC	V	
Input leakage current	I <sub>LKG</sub>	5		50	μA	

#### 4.1. LCD Power waste (Normal display) Top : Ta=25°C , Frame 60Hz

Parameter	Symbol	Conditions	Min.	Typ.	Max	worst	Unit	Remark
Current forIOVCC	I <sub>IOVCC</sub>	--	--	27	33	--	mA	--
Current for VCI	I <sub>VCC</sub>	--	--	/	/	--	mA	--
Current for AVDD	I <sub>AVDD</sub>	--	--	9	11	--	mA	--
Current for AVEE	I <sub>AVEE</sub>	--	--	9	11	--	mA	--
Power Consumption	P <sub>LCD</sub>	--	--	153	187	--	mW	Without backlight

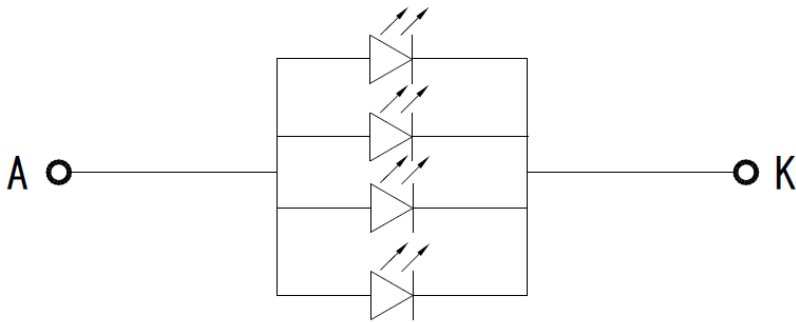
**4.2. LCD Power waste (Sleep mode ) Top : Ta=25°C , Frame 60Hz**

Parameter	Symbol	Conditions	Min.	Typ.	Max	worst	Unit	Remark
Current for IOVCC	I <sub>IOVCC</sub>	--	--	38	46	--	uA	--
Current for VCI	I <sub>VCI</sub>	--	--	/	/	--	uA	--
Current for AVDD	I <sub>AVDD</sub>	--	--	25	30	--	uA	--
Current for AVEE	I <sub>AVEE</sub>	--	--	26	32	--	uA	--
Power Consumption	P <sub>LCD</sub>	--	--	0.364	0.442	--	mW	Without backlight

**4.3. LED backlight Power waste Top : Ta=25°C**

Number of LED: 4pcs, LED current: 20mA@1pcs

Circuit of LED:



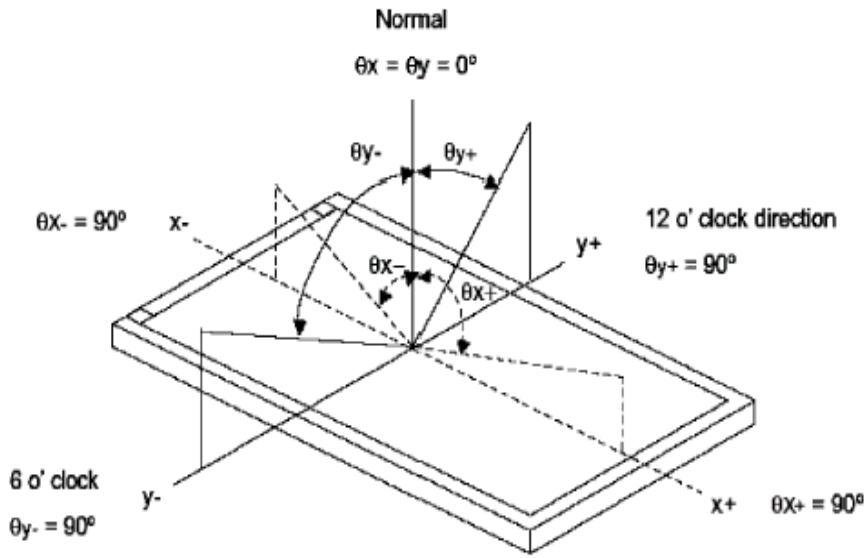
Parameter	Symbol	Conditions	Min.	Typ.	Max	Unit	Remark
LED forward Current	I <sub>LED</sub>	--	--	80	--	mA	@4lane
LED forward Voltage		I <sub>LED</sub> =20mA	--	3.2	--	V	@1lane
Power Consumption		I <sub>LED</sub> =80mA	--	256	--	mW	@4lane

## 5. OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITIONS	SPECIFICATIONS			UNIT	NOTE	
			MIN.	TYP.	MAX			
Brightness	B	Viewing normal angle	300	350	--	Cd/m <sup>2</sup>	All left side data are based on LONGYU's product reference only	
Contrast Ratio	CR		640	800	--	--		
Response Time	Tr+Tf		--	20	--	ms		
CIE Color coordinate	Red		X <sub>R</sub>	--	0.647	--		
			Y <sub>R</sub>	--	0.317	--		
	Green		X <sub>G</sub>	--	0.275	--		
			Y <sub>G</sub>	--	0.582	--		
	Blue		X <sub>B</sub>	--	0.140	--		
			Y <sub>B</sub>	--	0.088	--		
White	X <sub>W</sub>		--	0.29	--			
	Y <sub>W</sub>	--	0.31	--				
Viewing Angle	Hor.	$\theta_{x+}$	--	80	--	Deg.		
		$\theta_{x-}$	--	80	--			
	Ver.	$\theta_{y+}$	--	80	--			
		$\theta_{y-}$	--	80	--	--		
NTSC			--	50%		CIE1931		
Uniformity	Un		80	--	--	%		



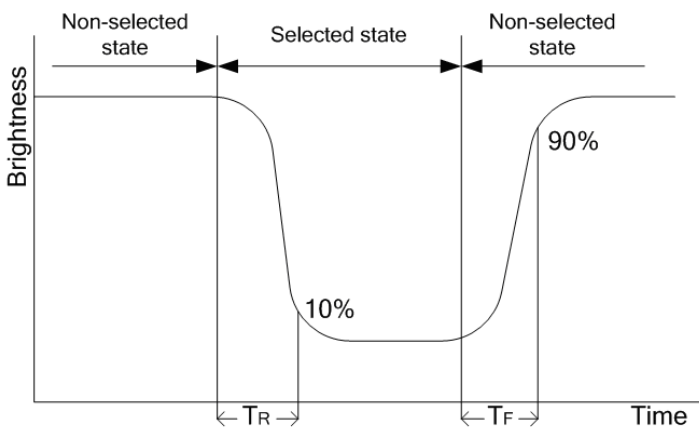
Note 1 : Definition of Viewing Angle  $\theta_x$  and  $\theta_y$  :



Note 2: Definition of contrast ratio CR:

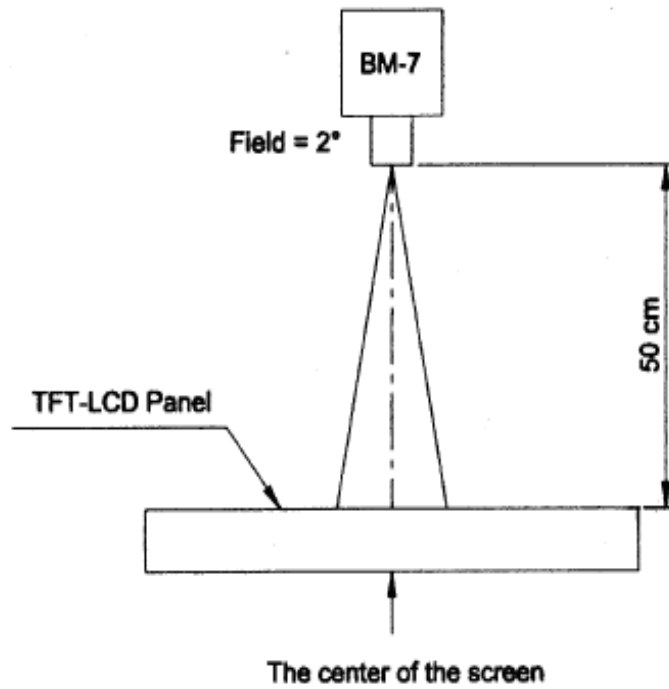
$$CR = \frac{\text{Brightness of non-selected dots (white)}}{\text{Brightness of selected dots (black)}}$$

Note 3: Definition of response time ( $T_R$ ,  $T_F$ )

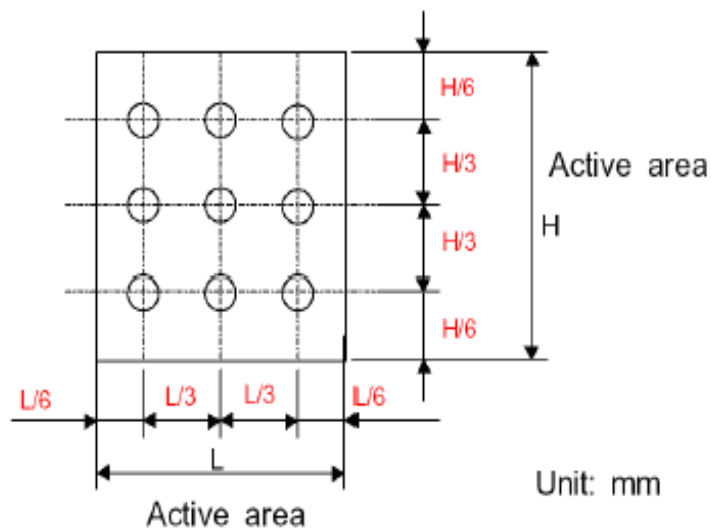


: The brightness test equipment setup

20mA (One LED) Field=2° (As measuring "black" image, field=2° is the best testing condition)



Note 4 :



## 6. Pin Assignment

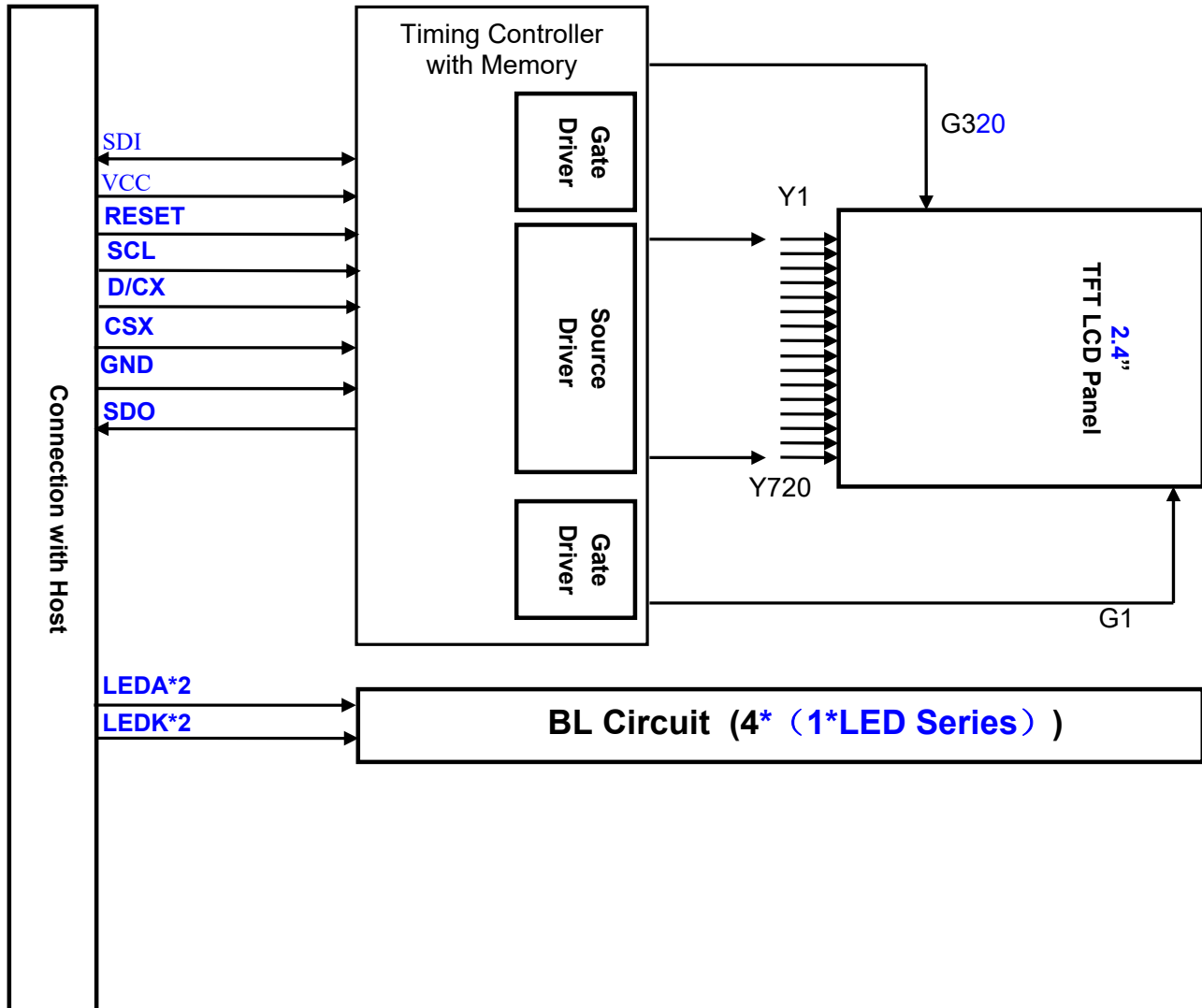
### TFT LCD Panel Driving Section

FPC Connector is used for the module electronics interface. The recommended model is "FH12-16S-1SH" manufactured by Hirose.

NO.	SYMBOL	I/O	Description
1	GND	I	Power ground
2	RESET	I	Reset Pin.
3	SCL	I	SPI clock signal
4	D/CX	I	Data/command select
5	CSX	I	Chip select
6	SDI	I	SPI data in
7	SDO	O	SPI data out
8	GND	P	Power ground
9	VCC	I	Power input
10	LEDA	P	Backlight anode
11	LEDK	P	Backlight cathode
12	NC	-	NO connection
13	NC	-	NO connection
14	NC	-	NO connection
15	NC	-	NO connection
16	NC	-	NO connection

## 7. BLOCK DIAGRAM

Driver IC: ST7789T3 or Compatible



## 8. LCM Quality Criteria

### 8.1. VISUAL & FUNCTION INSPECTION STANDARD

#### 8.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

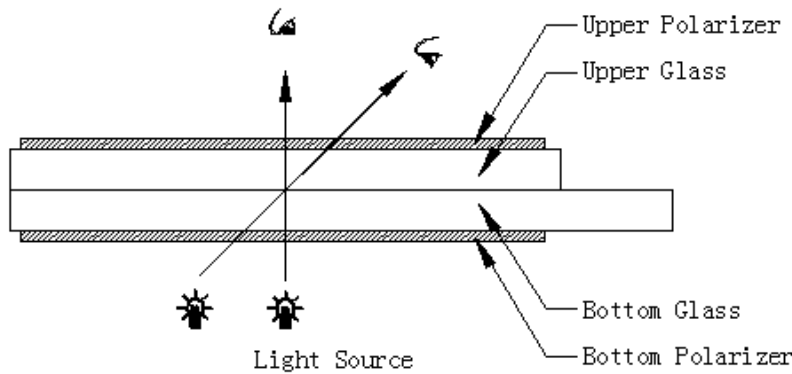
Temperature : 25±5°C

Humidity : 65%±10%RH

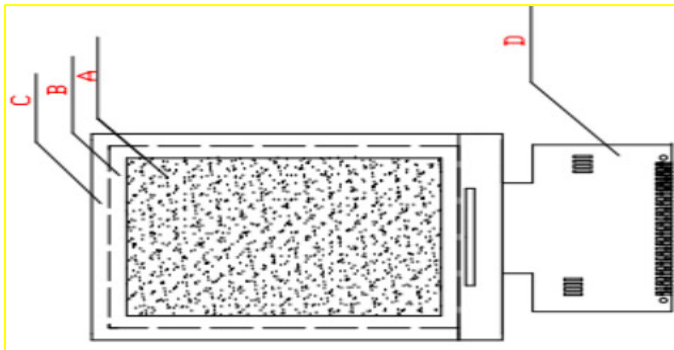
Viewing Angle : Normal viewing Angle(90° ±45° );

Illumination: Single fluorescent lamp (800~1200 LUX);

Viewing distance: 25-35cm , time: 5-10s;



#### 8.1.2 Definition



Zone A : LCD AA

Zone B : Viewing Area

Zone C : Outside of the Viewing Area

Note:

As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer.

#### 8.1.3 Sampling Plan

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

AQL:

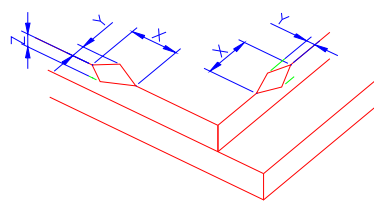
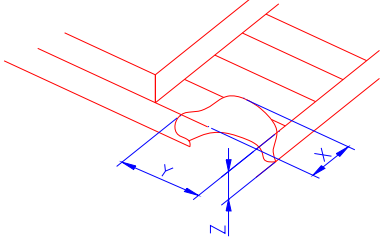
Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

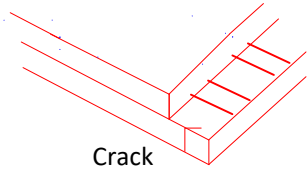
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No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display 2) Display abnormally 3) Missing vertical, horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting 6)Cross-Talk 7)Noise 8)Color contrast	Major
2	Missing	Missing component	Minor
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	
5	Soldering appearance	Good soldering , Peeling off is not allowed.	Major
6	LCD/Polarizer	Black/White spot/line, scratch, crack, etc.	
7	mura	ND5%, 128 gray	Minor
8	Cross-talk	≤ 5%	Minor

**8.1.4 Criteria (Visual)**

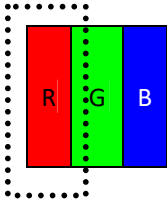
Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken	(1) The edge of LCD broken	 <table border="1" data-bbox="842 1193 1372 1346"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤1.5mm</td> <td>&lt;Inner border line of the sel</td> <td>≤T/2</td> </tr> </tbody> </table>	X	Y	Z	≤1.5mm	<Inner border line of the sel	≤T/2
	X	Y	Z					
≤1.5mm	<Inner border line of the sel	≤T/2						
(2)LCD corner broken	 <table border="1" data-bbox="901 1624 1316 1697"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3mm</td> <td>≤2mm</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3mm	≤2mm	≤T	
X	Y	Z						
≤3mm	≤2mm	≤T						

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	(3) LCD crack	 <p>Crack Not allowed</p>
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Number	Items	Criteria (mm)																																								
2.0	Spot defect	<p>① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)</p> <table border="1" style="width: 100%;"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.10</math></td> <td colspan="2">Ignore</td> <td rowspan="4">Ignore</td> </tr> <tr> <td><math>0.10 &lt; \Phi \leq 0.15</math></td> <td colspan="2">2</td> </tr> <tr> <td><math>0.15 &lt; \Phi \leq 0.2</math></td> <td colspan="2">1</td> </tr> <tr> <td><math>0.2 &lt; \Phi</math></td> <td colspan="2">0</td> </tr> </tbody> </table> <p>② Dim spot (LCD/TP/Polarizer dim dot, light leakage、dark spot)</p> <table border="1" style="width: 100%;"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable ty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.1</math></td> <td colspan="2">Ignore</td> <td rowspan="4">Ignore</td> </tr> <tr> <td><math>0.1 &lt; \Phi \leq 0.2</math></td> <td colspan="2">2(D&gt;10mm)</td> </tr> <tr> <td><math>0.2 &lt; \Phi \leq 0.3</math></td> <td colspan="2">1</td> </tr> <tr> <td><math>\Phi &gt; 0.3</math></td> <td colspan="2">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.10$	Ignore		Ignore	$0.10 < \Phi \leq 0.15$	2		$0.15 < \Phi \leq 0.2$	1		$0.2 < \Phi$	0		Zone Size (mm)	Acceptable ty			A	B	C	$\Phi \leq 0.1$	Ignore		Ignore	$0.1 < \Phi \leq 0.2$	2(D>10mm)		$0.2 < \Phi \leq 0.3$	1		$\Phi > 0.3$	0	
	Zone Size (mm)	Acceptable Qty																																								
A		B	C																																							
$\Phi \leq 0.10$	Ignore		Ignore																																							
$0.10 < \Phi \leq 0.15$	2																																									
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$\Phi > 0.3$	0																																									
	Line defect (LCD /Polarizer black/white line, scratch, stain)	<table border="1" style="width: 100%;"> <thead> <tr> <th>Width(mm)</th> <th>Length(mm)</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.03</math></td> <td>Ignore</td> <td>Ignore</td> </tr> <tr> <td><math>0.03 &lt; W \leq 0.05</math></td> <td><math>L \leq 1.5</math></td> <td>1</td> </tr> <tr> <td><math>0.05 &lt; W</math></td> <td colspan="2"><math>W &gt; 0.05</math> for Spot defect</td> </tr> </tbody> </table>	Width(mm)	Length(mm)	Acceptable Qty	$\Phi \leq 0.03$	Ignore	Ignore	$0.03 < W \leq 0.05$	$L \leq 1.5$	1	$0.05 < W$	$W > 0.05$ for Spot defect																													
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3.0	Polarizer scratch	<table border="1"> <thead> <tr> <th>Width(mm)</th> <th>Length(mm)</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td><math>W \leq 0.03</math></td> <td>Ignore</td> <td>Ignore</td> </tr> <tr> <td><math>0.03 &lt; W \leq 0.05</math></td> <td><math>L \leq 5</math></td> <td>1</td> </tr> <tr> <td><math>0.05 &lt; W</math></td> <td>0</td> <td>0</td> </tr> </tbody> </table>	Width(mm)	Length(mm)	Acceptable Qty	$W \leq 0.03$	Ignore	Ignore	$0.03 < W \leq 0.05$	$L \leq 5$	1	$0.05 < W$	0	0		
	Width(mm)	Length(mm)	Acceptable Qty													
$W \leq 0.03$	Ignore	Ignore														
$0.03 < W \leq 0.05$	$L \leq 5$	1														
$0.05 < W$	0	0														
	Polarizer Bubble	<table border="1"> <thead> <tr> <th>Zone Size (mm)</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.1</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.1 &lt; \Phi \leq 0.2</math></td> <td>2 (<math>D \geq 15\text{mm}</math>)</td> </tr> <tr> <td><math>0.2 &lt; \Phi</math></td> <td>0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty	$\Phi \leq 0.1$	Ignore	$0.1 < \Phi \leq 0.2$	2 ( $D \geq 15\text{mm}$ )	$0.2 < \Phi$	0						
Zone Size (mm)	Acceptable Qty															
$\Phi \leq 0.1$	Ignore															
$0.1 < \Phi \leq 0.2$	2 ( $D \geq 15\text{mm}$ )															
$0.2 < \Phi$	0															
4.0	SMT	According to the <Acceptability of electronic assemblies> IPC-A-610C class 2 standard. Component missing or function defect are Major defect, the others are Minor defect.														
5.0	TFT	<table border="1"> <thead> <tr> <th>distinguish</th> <th>type</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Bright dot</td> <td>Any color window</td> <td>0</td> </tr> <tr> <td>Adjacent Bright dot</td> <td>0</td> </tr> <tr> <td rowspan="2">Dark dot</td> <td>Dark dot</td> <td>2</td> </tr> <tr> <td>Adjacent Dark dot</td> <td>0</td> </tr> </tbody> </table> <p>Note: the red (R), green, blue (G), (B) 3 points constitute a pixel</p>	distinguish	type	Acceptable Qty	Bright dot	Any color window	0	Adjacent Bright dot	0	Dark dot	Dark dot	2	Adjacent Dark dot	0	 <p>Dot</p>
distinguish	type	Acceptable Qty														
Bright dot	Any color window	0														
	Adjacent Bright dot	0														
Dark dot	Dark dot	2														
	Adjacent Dark dot	0														



## 8.2. RELIABILITY TEST

ITEM	Condition	Sample size	Criterion
High Temp. Storage	70°C, 48hrs	5pcs	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.Missing segments; 5. The surface shall be free from damage. 6. Contrast must be no more than 10% by the linearity tester. 7. Power must be no more than 10% by the linearity tester.
Low Temp. Storage	-30°C, 48 hrs	5pcs	
High Temp. Operation	60°C,48 hrs	5pcs	
Low Temp. Operation	-20°C, 48 hrs	5pcs	
Humidity operation	40°C,90%RH ,48 hrs	5pcs	
Humidity storage	60°C,90%RH ,48 hrs	5pcs	
Thermal shock	-30°C/30min → 70°C/30mins Total:16cycles	5pcs	
Simulated transport	Reciprocating, 190+/-10 Ring, 2 hours, amplitude 25.4MM	1Carton-box	After testing, there are no any defective appearances or electrical properties.
Packaging drop	Six faces , Three edge ( Diagonal landing ) , The weight and height correspond to the following 0 to 45.4KG: 80CM ; 45.4-90.8KG : 60CM ; 90.8-454KG: 45CM; OVER454KG: 40CM	1Carton-box	
ESD	1.Contact discharge method ±4KV, 150pF/330Ω 10times ( Can not face the role of IC )	5pcs	1. After testing, there are no any defective appearances or electrical properties.
	2.Air discharge method ±4KV,150pF/330Ω 10times ( Can not face the role of IC )	5pcs	2. It can be acceptable when all defective ESD disappears in the RESET.