Specification of Display Module

Customer Model Name	
Module Name	
Version No.	V00 2022-06-06

Customer Approval:

□ **Approve Specification Only**

□ **Approve Specification and Sample**

Approved By
Data

Designed By	Checked By	Approved By
LiuPeng	HeJunCheng	LiXingyuan

Revision Record

Date	Rev.	Description	Chapter	Remarks
2022/06/06	V00	Initial Released	All	

Contents

1. Introduction

This display module is designed by **UMUSTECH CO., LTD.** in Shenzhen China.

All materials and processes of this display module are Lead Free.

2. General Specification

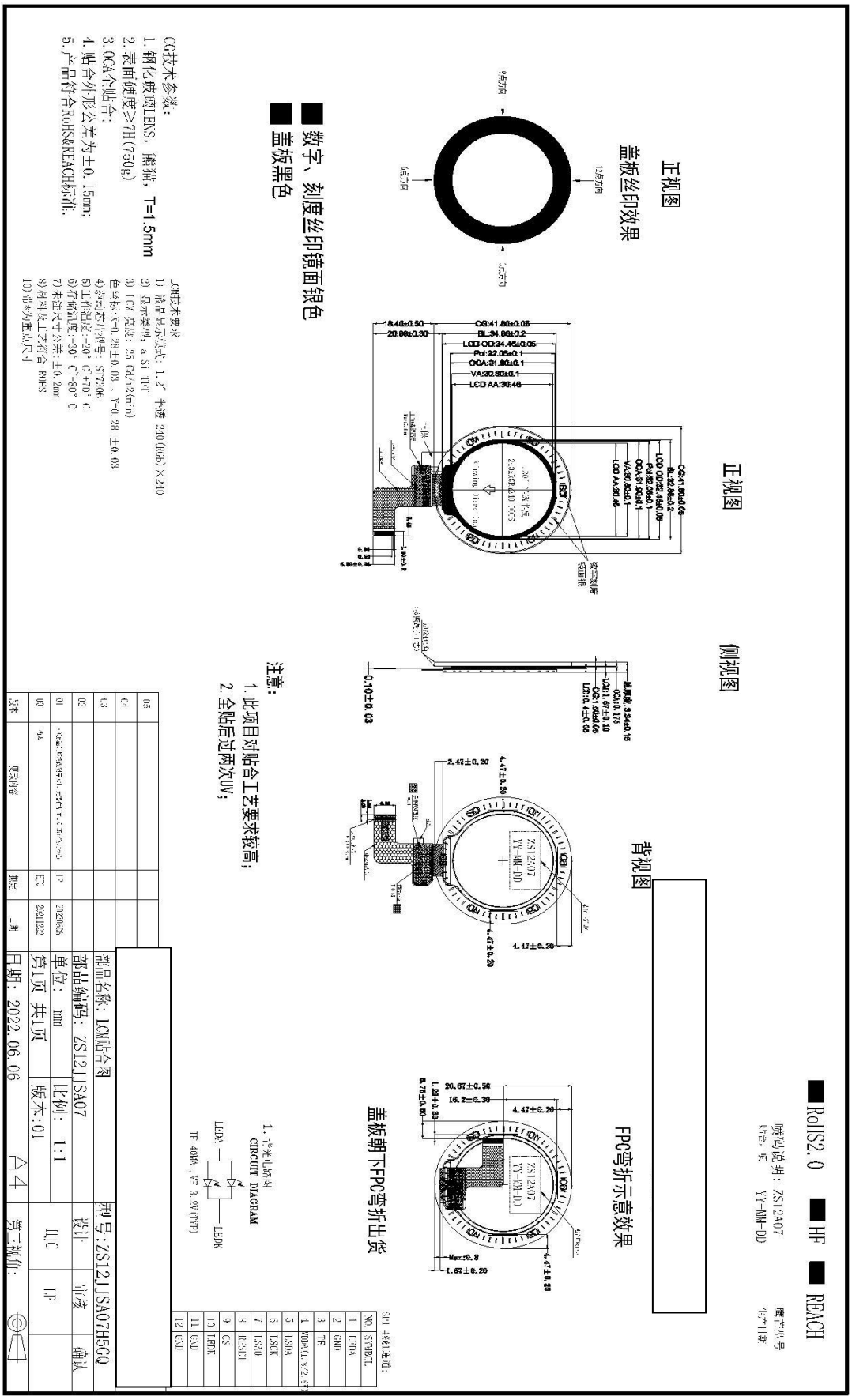
2.1 LCM General Specification

Item	Content	Unit
LCM Size (inch)	1.2″	inch
Active Area (W×H)	30.456×30.456	mm
Module Size (W×H×T)	41.80*41.80*3.34	mm
LCD Type	a-Si TFT	/
Recommended Viewing Virection	TBD	o'clock
Number of Dots	240*(RGB)*240	Dots
Pixel Size	126.9×126.9	um
Driver IC	ST7306	/
Interface Type	SPI 4Lens	/
Approx. Weight	TBD	g
Backlight Type	White LED	/
NTSC	12%(Min)	/

2.2 TP General Specification

Item	Content	Unit
TP Outline Dimension (W×H×T)	N/D	mm
TP View Area (W×H)	N/D	mm
Lamination Mode with LCM	N/D	/
Touch IC	N/D	/
Interface Type	N/D	/
Touch Structure	N/D	/
Cover Lens Hardness	N/D	/
Lens Surface Treatment	N/D	/

3. Mechanical Drawing



4. LCM Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	IOVCC	1.65	3.3	V
DC/DC converter circuit output	VCC	2.4	3.3	V
Driver Supply Voltage	VGH	8	16.5	V
Driver Supply Voltage	VGL	-15	-6	V
Input voltage for logic	Vt	1.65	IOVCC +0.3	V
Operating temperature	Top	-20	+70	℃
Storage temperature	Tst	-30	+80	℃

5. Electrical Characteristics

5.1 LCD Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit
Supply voltage for logic	IOVCC	1.65	1.8	3.3	V
supply voltage for analogic	VCC	2.8	2.8	3.3	V
Input voltage	V_{IL}	-0.3	-	0.3 IOVCC	V
	V_{IH}	0.8 IOVCC	-	IOVCC	V
Input leakage current	I_{LKG}	-	10	15	μA

5.2 Backlight Characteristics

Item	symbol	Min.	Typ.	Max	Unit	Condition
Forward voltage	Vf	2.8	3	3.25	V	If=40mA
Number of LED	-	2			Piece	-
Connection mode	P	2 parallel			-	-

6. LCM Optical Characteristics

6.1 Optical Specification

Reflective mode

Item		Symbol	Condition	Specifications			Unit	Remark
				Min.	Typ.	Max.		
Brightness		Lv	Viewing normal angle Θ= 0 °	6	8	--	Cd/m2	Note 2
Contrast Ratio		CR		7	10	--	/	Note 1
Response Time		Tr+Tf		--	20	30	ms	Note 4
Chromaticity CIE(x,y)	Red	x		TBD			/	Note 6
		y		TBD			/	
	Green	x		TBD			/	
		y		TBD			/	
	Blue	x		TBD			/	
		y		TBD			/	
	White	x		TBD			/	
		y		TBD			/	
Viewing Angle	Hor.	θ_{X+}	Center CR>=2	45	60	--	Deg.	Note 5
		θ_{X-}		45	60	--		
	Ver.	θ_{Y+}		45	60	--		
		θ_{Y-}		45	60	--		
Luminance Uniformity		White		12	15	--	%	Note 3

Remark:

1.The Reflective, NTSC and Contrast Ratio are the emulated values base on the panel with special polarizer, with compensation film and LDF, and C-Light.

2.LCM brightness is the test brightness when the external backlight power supply (I=0mA) is turned off;

Transmittance mode

Item		Symbol	Condition	Specifications			Unit	Remark
				Min.	Typ.	Max.		
Brightness		Lv	Viewing normal angle Θ= 0 °	25	--	--	Cd/m2	Note 2
Contrast Ratio		CR		15	20	--	/	Note 1
Response Time		Tr+Tf		--	20	30	ms	Note 4
Chromaticity CIE(x,y)	Red	x		0.45±0.03			/	Note 6
		y		0.32±0.03			/	
	Green	x		0.31±0.03			/	
		y		0.45±0.03			/	
	Blue	x		0.17±0.03			/	
		y		0.14±0.03			/	
	White	x		0.28±0.03			/	
		y		0.28±0.03			/	
Viewing Angle	Hor.	θ_{X+}	Center CR>=2	15	25	--	Deg.	Note 5
		θ_{X-}		15	25	--		
	Ver.	θ_{Y+}		25	35	--		
		θ_{Y-}		25	35	--		
Luminance Uniformity		White		15	18	--	%	Note 3

Remark:
1.Light Source: C-light (Polarizer with compensation film)
2.The Reflective, NTSC and Contrast Ratio are the emulated values base on the panel with special polarizer, with compensation film and LDF, and C-Light.
3. LCM brightness is the test brightness under an external backlit power supply (I=40mA);

Note1. Contrast Ratio (CR) is defined mathematically by the following formula. For more information see FIG 1.:

Contrast Ratio = Average Surface Luminance with all white pixels (P1, P2, P 3, P4,P5,P6,P7,P8,P9) / Average Surface Luminance with all black pixels (P1, P2, P 3, P4,P5,P6,P7,P8,P9)

Note2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 1.

Lv = Average Surface Luminance with all white pixels (P1, P2, P 3,P4, P5,P6,P7,P8,P9)

Note3. The uniformity in surface luminance（ δ 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 1 .

WHITE = Minimum Surface Luminance with all white pixels (P1, P2,P3,P4,P5,P6,P7,P8,P9) / Maxi mum Surface Luminance with all white pixels (P1, P2,P3,P4,P5,P6,P7,P8,P9)

Note4. Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 2.

Note5. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast ratio is greater than 10. The 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.

Note6. CIE (x, y) chromaticity ,The x,y value is determined by screen active area position 5. For more information see FIG 1.

Note7: NTSC ratio：For more information see FIG 4.

NTSC ratio = Area of RGB triangle / Area of NTSC triangle

Note8. For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments. For contrast ratio, Surface Luminance, Luminance uniformity and CIE, the testing data is base on BM-7 photo detector.

Note9. For TFT transmissive module, Gray scale reverse occurs in the direction of panel viewing Angle

FIG.1. Measuring method for Contrast ratio,surface luminance, Luminance uniformity,CIE (x,y) chromaticity

A :H/6 mm

B : V/6 mm

H,V : Active Area

Light spot size Ø=5mm, 500mm distance from the LCD surface to detector lens measurement instrument is luminance meter BM-7

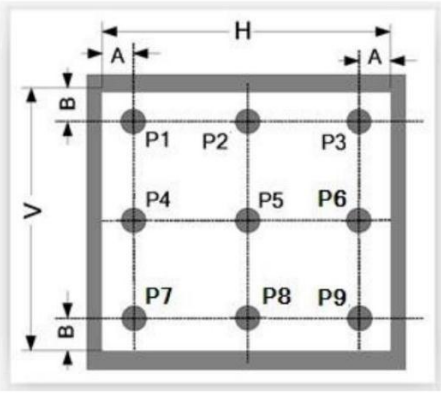


FIG.2. The definition of Response Time 响应时间定义

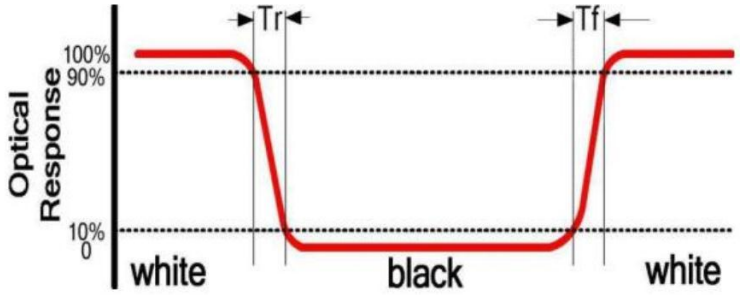
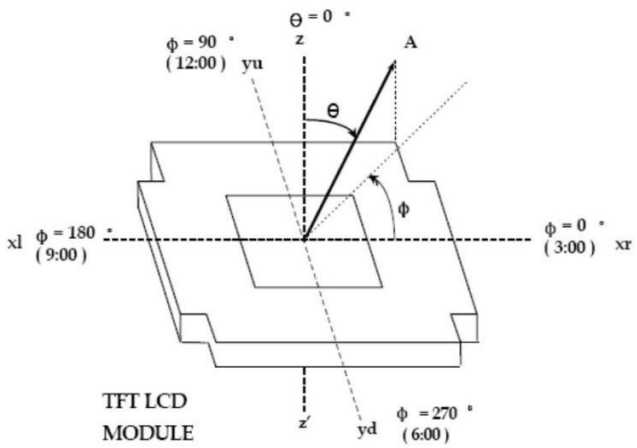
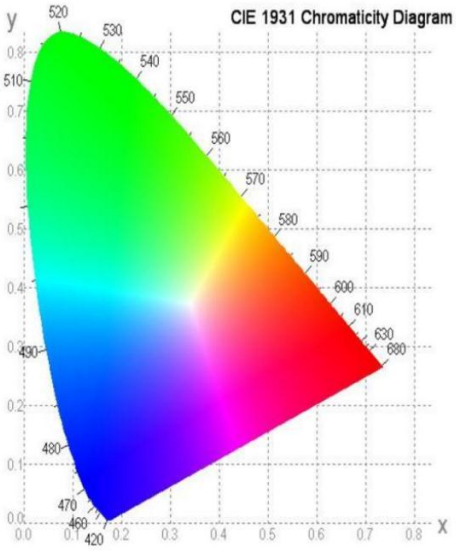


FIG.3. The definition of viewing angle 视角定义

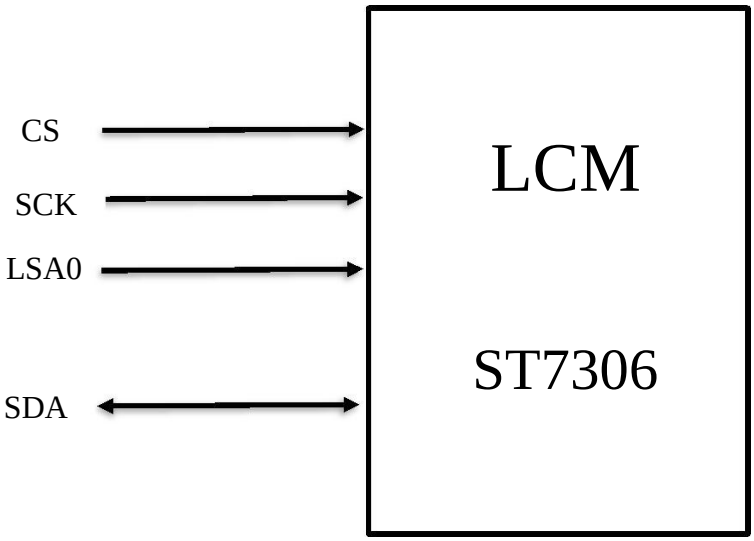




7. Display Module Interface Description(Pin Definition)

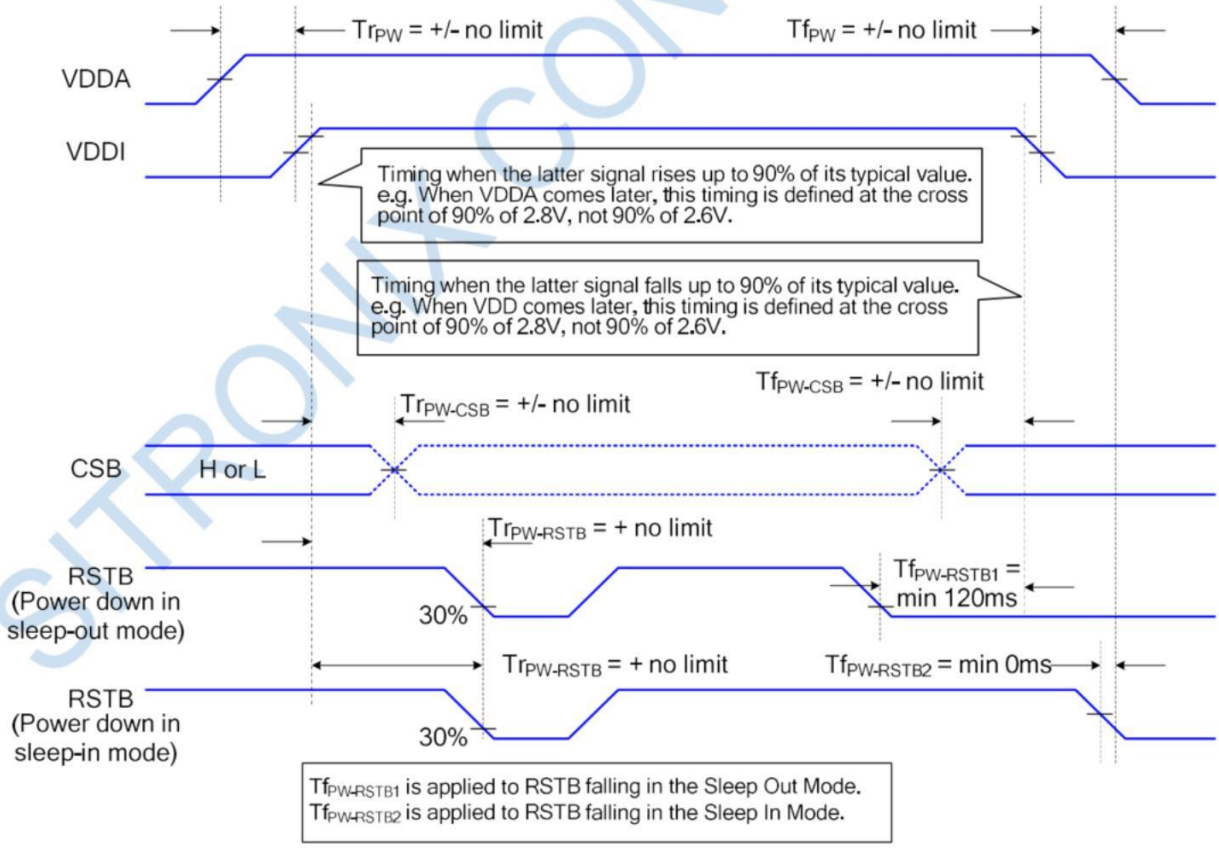
NO.	SYMBOL	Description	I/O
1	LEDA	Power for LED backlight (Anode)	P
2	GND	Ground	P
3	GND	Ground	P
4	VDD	Power supply voltage(2.8v~3.3v)	P
5	SDA	Serial input/output data	I/O
6	SCK	Serial input clock	I
7	LSA0	Data or command select	I
8	RESET	Reset signal	I
9	CS	Chip select input pin.	I
10	LEDK	Power for LED backlight (Cathode)	P
11	GND	Ground	P
12	GND	Ground	P

8.LCM Block Diagram



8.1 Power ON/OFF Sequence

The power on/off sequence is illustrated below



9. Caution

9.1 Handling of Display Module

Be sure to ground the body when handling the LCM.

Don’t give external shock.

Don’t apply excessive force on the surface.

Liquid in LCD is hazardous substance. Must not lick and swallow.

When the liquid is attach to your hand, skin, cloth etc. Wash it out thoroughly and immediately.

Don’t operate it above the absolute maximum rating.

Don’t disassemble the LCM.

9.2 Storage

Store in an ambient temperature of 5℃ to 45℃,and in a relative humidity of 40% to 60%. Don’t expose to sunlight or intensive ultraviolet rays.

Storage in a clean environment, free from dust, active gas, and solvent.

Store in anti-static electricity container.

Store without any physical load.

10.

Display Module Quality Criteria (Visual & Function Inspection Standard)

Inspection performed under the following conditions is recommended.

10.1 Inspection Conditions

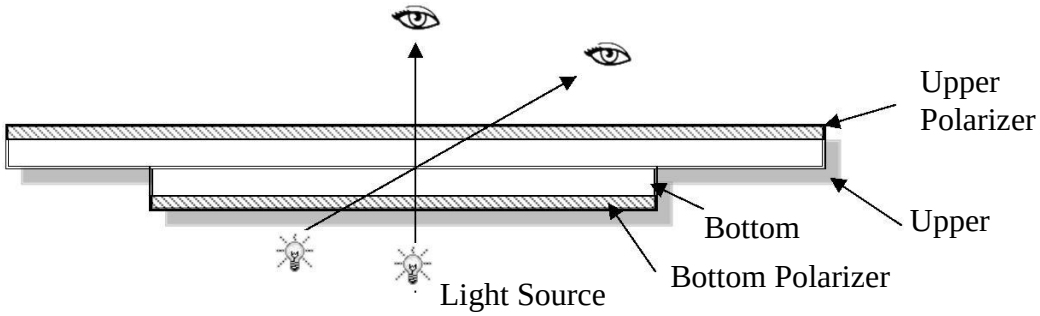
Temperature : 25±5℃

Humidity : 65%±10%RH

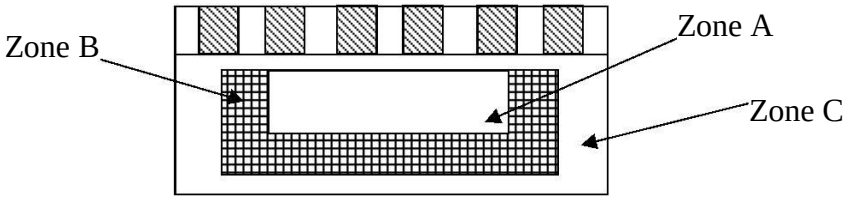
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



10.2 Zone Definition



Zone A : Effective Viewing Area(AA)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

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.

10.3 Inspection Specification

Sampling plan according to GB/T2828.1-2012/ISO 2859-1：1999 and ANSI/ASQC Z1.4-1993,normal level 2 and based on:

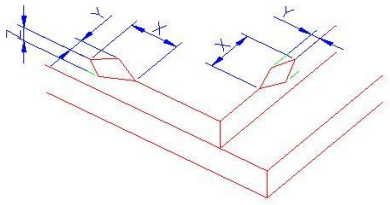
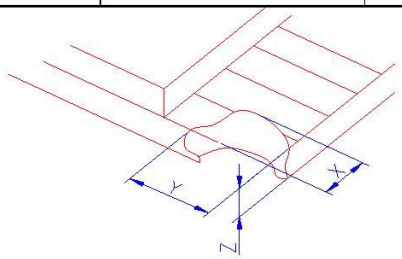
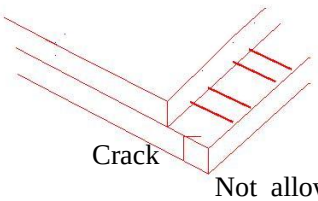
AQL:

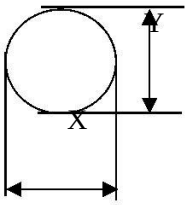
Major defect	Minor defect
0.4	1.0

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Soldering appearance	Good soldering , Peeling off is not allowed.	
6	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	
7	Linearity	No more than 1.5%	

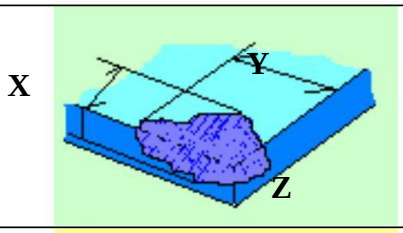
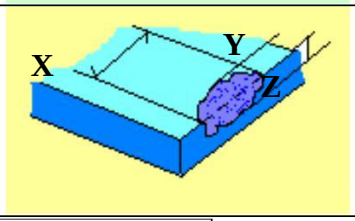
10.4 Criteria (Visual)

<table>
<tr><th>Number</th><th>Items</th><th>Criteria(mm)</th></tr>
<tr><td rowspan="3">1 LCD Crack/Broken

NOTE:
X: Length
Y: Width
Z: Height
L: Length of ITO,
T: Height of LCD</td><td>The edge of LCD broken</td><td> 
<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr></table></td></tr>
<tr><td>LCD corner broken</td><td> 
No effective fuction
<table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr></table></td></tr>
<tr><td>LCD crack</td><td> 
Crack
Not allowed</td></tr>
</table>

<table>
<tr><th>Number</th><th>Items</th><th>Criteria (mm)</th></tr>
<tr><td rowspan="2">2</td><td>Clear Spot defect
 

Φ=(X+Y)/2</td><td>1.light dot（LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain）
<table>
<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>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.1<Φ≤0.2</td><td colspan="2">2(distance≧5mm)</td></tr>
<tr><td>Φ>0.2</td><td colspan="2">0</td></tr>
</table>
2.Dim spot（LCD/TP/Polarizer dim dot, light leakage、dark spot）
<table>
<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>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1<Φ≤0.2</td><td colspan="2">2(distance≧5mm)</td></tr>
<tr><td>0.2<Φ≤0.25</td><td colspan="2">1</td></tr>
<tr><td>Φ＞0.25</td><td colspan="2">0</td></tr>
</table>
3.TP Dirt
<table>
<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>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.1<Φ≤0.25</td><td colspan="2">2(distance≧5mm)</td></tr>
<tr><td>Φ>0.25</td><td colspan="2">0</td></tr>
</table></td></tr>
<tr><td>Line defect (LCD/TP /Polarizer black/white line, foreign material on Polarizer scratch, stain)</td><td>
<table>
<tr><th rowspan="2">Width(mm)</th><th rowspan="2">Length(mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.02</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.02<W≤0.03</td><td>L≤2.0</td><td colspan="2">N≤1</td></tr>
<tr><td>0.03<W≤0.05</td><td>L≤1.0</td><td colspan="2">N≤1</td></tr>
<tr><td>W>0.05</td><td colspan="4">Define as spot defect</td></tr>
</table></td></tr>
<tr><td>3</td><td>Polarizer Bubble</td><td>
<table>
<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>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.1<Φ≤0.25</td><td colspan="2">2(distance≧5mm)</td></tr>
<tr><td>Φ>0.25</td><td colspan="2">0</td></tr>
</table></td></tr>
<tr><td>4</td><td>SMT</td><td>According to IPC-A-610C class II standard . Function defect and missing part are major defect ,the others are minor defect.</td></tr>
</table>

<table>
<tr><td rowspan="3">5</td><td>Newton Ring</td><td>Newton Ring area>1/6 TP area NG
Newton Ring area≤1/6 TP area OK</td><td>  </td></tr>
<tr><td></td><td>Rule-less Newton Ring area>1/4 TP area NG
Rule-less Newton Ring area≤1/4 TP area OK</td><td>  </td></tr>
<tr><td>TP corner broken
X：length
Y：width
Z：height</td><td><table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>X≤2.0mm</td><td>Y≤2.0mm</td><td>Z<Lens thickness</td></tr></table>*Circuitry broken is not allowed.</td><td>  </td></tr>
<tr><td>TP edge broken
X：length
Y：width
Z：height</td><td><table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>X≤2.0mm</td><td>Y≤0.15mm</td><td>Z<lens thickness</td></tr></table>* Circuitry broken is not allowed.</td><td>  </td></tr>
<tr><td>6</td><td>TP Dirt</td><td colspan="2"><table><tr><td>Zone
Size (mm)</td><td colspan="2">Acceptable Qty
A</td><td>B</td><td>C</td></tr><tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr><tr><td>0.1<Φ≤0.2</td><td colspan="2">2(distance≧5mm)</td></tr><tr><td>Φ>0.2</td><td colspan="2">0</td></tr></table></td></tr>
<tr><td>7</td><td>Foreign material on TP film</td><td colspan="2">The line can be seen after mobile phone in the operating condition<table><tr><td rowspan="2">Width(mm)</td><td rowspan="2">Length(mm)</td><td colspan="3">Acceptable Qty</td></tr><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>Φ≤0.03</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="2">Ignore</td></tr><tr><td>0.03<W≤0.05</td><td>L≤3.0</td><td colspan="2">N≤2</td></tr><tr><td>W>0.05</td><td colspan="4">L>3 Define as spot defect</td></tr></table></td></tr>
<tr><td>8</td><td>Dim line defect
TP film scratch</td><td colspan="2">If the scratch can be seen after mobile phone cover assembling or in the operating condition judge by the standards of foreign material on TP film,
if the scratch can be seen only in non-operating operation or some special angle,judge by the following<table><tr><td rowspan="2">Width(mm)</td><td rowspan="2">Length(mm)</td><td colspan="3">Acceptable Qty</td></tr><tr><td>A</td><td>B</td><td>C</td></tr><tr><td>Φ≤0.03</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr><tr><td>0.03<W≤0.05</td><td>L≤3.0</td><td colspan="2">N≤2</td></tr><tr><td>W>0.05</td><td colspan="3">Define as spot defect</td></tr></table></td></tr>
<tr><td>9</td><td>Pattern font</td><td colspan="2">Pattern fonts are clear and symmetrical, Pattern fonts filter lightly are allowed; the fort line is not allow to thinner or thicker than 1/3 of normal size,and swing is not more than 0.1mm,the line is smooth and not broken</td></tr>
</table>

11. Reliability Test

NO	ITEM	CONDTTION	STANDARD
1	High Temp. Storage	80℃, 48 hours	1. Functional test is OK. Missing Segment, short, unclear segment, non-display, display abnormally and liquid crystal leak are not allowed. 2. No low temperature bubbles, end seal loose and fall, frame rainbow.
2	Low Temp. Storage	-40℃, 48 hours	
3	High Temp. Operation	70℃, 48hours	
4	Low Temp. Operation	-30℃, 48 hours	
5	High temperature and high Humidity storage	50℃±5℃,90%RH ,120 hours	
6	Thermal and cold shock	Static state， -20℃（30 Min）~70℃（30 Min）~ -20℃（30Min），packaging，10 cycles	
7	Vibration test	Packaging，Frequency : 10-55Hz Amplitude : 1.0mm， Each direction on X,Y axe 1 hour，	1. Function test is OK. 2. No glass crack, chipped glass, end seal loose and fall, epoxy frame crack and so on. 3. No structure loose and fall.
8	Dropping test	Pack products into the carton box. Drop it from 100cm height to ground. Once for each side of the carton	

Notes ：

11.1 The reliability items will be fully performed in new sample qualification,

11.2 The reliability status will be tested as monitor during mass production. Individual reliability test shall be performed by lot , Moreover, the individual reliability item shall be decided according to reliability plan.

11.3 All samples are inspected after keeping in the room with normal temperature and humidity for 2 hours or above.

11.4 Vibration test: It is not necessary to test for those products without assembly frame , back light ,PCB and so on.

11.5 Dropping test : It is necessary for affirming new package.

11.6 For the high temperature and high humidity test, pure water of over 10 MΩ.cm should be used.

11.7 Each test item applies for test LCM only once .Then tested LCM cannot be used again in any other test item.

11.8 The quantity of LCM examination for each test item is 5pcs to 10pcs.

12. Precautions for Using Display Modules

12.1 Safety instructions

12.1.1 If the LCD panel breaks, be careful not to get any liquid crystal substance in your mouth.

12.1.2 If the liquid crystal substance touches your skin or clothes, please wash it off immediately by using soap and water.

12.2 Handling Precautions

12.2.1 Avoid static electricity damaging the LSI.

12.2.2 Do not remove the panel or frame from the module .

12.2.3 The polarizing plate of the display is very fragile . So, please handle it very carefully.

12.2.4 Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of the plate.

12.2.5 The color tone of display and background of LCM has the possibility to be changed in the storage temperature range.

12.2.6 Pay attention to the working environment, as the element may be destroyed by static electricity.

--Be sure to ground human body and electric appliance during work.

--Avoid working in a dry environment to minimize the generations of static electricity.

--Static electricity may be generated when the protective film is fast peeled off.

12.2.7 When soldering the terminal of LCM, make certain the AC power source of soldering iron does not leak.

12.2.8 If the display surface becomes contaminated ,breathe on the surface and gently wipe it with a soft-dry- clean cloth .If it is heavily contaminated ,moisten cloth with the following solvent(ex:Ethyl alcohol).Solvents other than those above-mentioned may damage the polarizer.

12.3 Operation Instructions

12.3.1 It is recommended to drive the LCD within the specified voltage limits, try to adjust the operating voltage for the optimal contrast, the color and contrast of LCD panel will varies at different temperature.
12.3.2 Response time is greatly delayed at low operating temperature range. However, this does not mean the LCD will be out of the order, It will recover when it returns to the specified temperature range.
12.3.3 If the display area is pushed hard during operation, the display will become abnormal.
12.3.4 Do not operate the LCD at the environments over the specified conditions, this may cause damage on the LCD and shorten the lifetime.

12.4 Storage Instructions:

12.4.1 Store display module in a sealed polyethylene bag.
12.4.2 Store display module in a dark place, Do not expose to sunlight or fluorescent light. Keep the temperature between 0℃and 35℃.
12.4.3 Avoid the polarizer touch any other object, (It is recommended to store them in the container in which they were shipped.)

12.5 Limited Warranty

12.5.1 LEAD will replace or repair any of its LCD modules, which are found to be defective, when inspected in accordance with LEAD LCM acceptance standards (copies available upon request) for a period of 12 months from ink-print date on product
12.5.2 Any defects must be returned to LEAD within 60 days since ship-out. Confirmation of such date shall be based on freight documents. The warranty liability of LEAD limited to repair and/or replacement on defects above (7.1,7.2)
12.5.3 No warranty can be granted if the precautions stated above have been disregarded. The typical samples are as below:
-- LCD glass crack/break
--PCB outlet is damaged or modified.
--PCB conductors damaged.
--Circuit modified with by grinding, engraving or painting varnish.
--FPC crack
12.5.4 Modules must be returned with sufficient description of the failures of defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB outlet, conductors and terminals. Modules must be packed with the container in which they were shipped.

13. Packing Specification

-TBD-