



SPECIFICATION FOR LCD Module PV05028T0225Z-CO

MODULE:	PV05028T0225Z-CO
CUSTOMER:	

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REVISION STATUS

Version	Revise Date	Page	Content	Modified by
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1. General Description

* DESCRIPTION

PV05028T0225Z-CO is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This model is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 4.99" TFT-LCD contains 720 x 1280 pixels, and can display up to 16.7M colors.

* Features

- Low Input Voltage: IOVCC: 1.65~3.6V;VCC: 2.3~6.0V
- Display Colors of TFT LCD: 16.7M colors
- Interface: MIPI-4 Lanes
- Internal Power Supply Circuit.

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	62.10(H) *110.4 (V)	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	16.7M	colors	-
Number of pixels	720(RGB) *1280	dots	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.02875 (H) *0.08625 (V)	mm	-
Viewing angle	All	o'clock	-
Drive IC	GC9702P	-	-
Display mode	Normally black	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	72.10	-	mm	±0.05
	Vertical(V)	-	130.1	-	mm	±0.05
	Depth(D)	-	3.15	-	mm	±0.2
Weight		-	TBD	-	g	-



3.Pin Description

PIN No.	SYMBOL	LEVEL	DESCRIPTION
1	GND	L	Ground
2	MIPI-DP1	H/L	MIPI_DP1+ are differential data signal line
3	MIPI-DN1	H/L	MIPI_DP1- are differential data signal line
4	GND	L	Ground
5	MIPI-CLKP	H/L	CLOCK Lane positive-end input pin
6	MIPI-CLKN	H/L	CLOCK Lane negative-end input pin
7	GND	L	Ground
8	MIPI-DP0	H/L	MIPI_DP0+ are differential data signal line
9	MIPI-DN0	H/L	MIPI_DP0- are differential data signal line
10	GND	L	Ground
11	K	L	LED- P LED Cathode
12	K	L	LED- P LED Cathode
13	A	H	LED Anode
14	A	H	LED Anode
15	GND	L	Ground
16	VDD2.8	H	Power Voltage for digital circuit
17	GND	L	Ground
18	IOVDD1.8	H	Power Voltage for digital circuit
19	RESET	H/L	Global reset pin
20	TE	H/L	Tearing effect output
21	MIPI-DP2	H/L	MIPI_DP2+ are differential data signal line
22	MIPI-DN2	H/L	MIPI_DP2- are differential data signal line
23	LCD ID		Connct 10K resistance to IOVCC
24	MIPI-DP3	H/L	MIPI_DP3+ are differential data signal line
25	MIPI-DN3	H/L	MIPI_DP3- are differential data signal line

3.2 CTP PIN

1	SCL	H/L	Serial clock input
2	VCC	H/L	Power supply 3.3V
3	GND	L	Ground
4	GND	L	Ground
5	SDA	H/L	Serial data input pin
6	INT	H/L	Interrupt pin
7	REST	H/L	Hardware reset pin
8	IOVCC	H/L	Power supply 1.8V



4. ELECTRICAL CHARACTERISTICS

4.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Values		Unit	Remark
		Min	Max.		
Supply Voltage for Logic circuit	IOVDD	1.65	3.6	V	
Supply Voltage for analog circuit	Vcc	2.5	6.0	V	

4.2 DC ELECTRICAL CHARACTERISTICS

4.2.1 OPERATING CONDITIONS

Typical Operating Conditions (Ta=25°C)

Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
Power Supply	Vcc	2.5	2.8	6.0	V	
Power Supply	VDDIO	1.65	1.8	3.6	V	
Normal mode Current consumption	Icc	-	-	45	/	-
TFT Gate ON Voltage	VGH	17.5	18	18.5	V	
TFT Gate OFF Voltage	VGL	-10.5	-10	-9.5	V	

4.2.2 BACKLIGHT UNIT (GND=0V)

Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
Forward supply Voltage	Vf	16.8	-	20.4	V	
Forward supply Current	If	-	40	-	mA	
LCM Luminance	Lv	400	450	-	cd/m2	I _B =40mA
Uniformity	/	80			%	-



4.3 TIMING CHARACTERISTICS

8.8. AC Characteristic

8.8.1. DSI Timing Characteristics

8.8.1.1. High Speed Mode – Clock Channel Timing

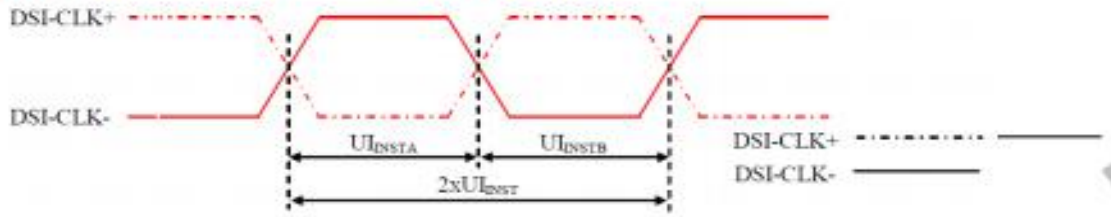


Figure 114 DSI Clock Channel Timing

Table 45 DSI Clock Channel Timing

Signal	Symbol	Parameter	Min	Max	Unit
DSI-CLK+/L	$2xUI_{INST}$	Double UI instantaneous	4	2.5	ns
DSI-CLK+/L	UI_{INSTA}, UI_{INSTB}	UI instantaneous Half	2	12.5	ns

Note: $UI = UI_{INSTA} = UI_{INSTB}$

8.8.1.2. High Speed Mode – Data Clock Channel Timing

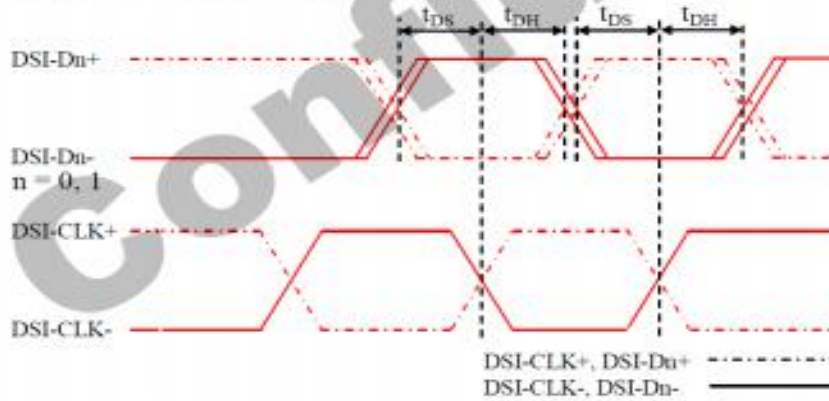


Figure 115 DSI Data to Clock Channel Timings

Table 46 DSI Data to Clock Channel Timings

Signal	Symbol	Parameter	Min	Max
DSI-Dn+/-, n=0 and 1	t_{DS}	Data to Clock Setup time	$0.15xUI$	-
	t_{DH}	Clock to Data Hold Time	$0.15xUI$	-



8.8.1.3. High Speed Mode – Rise and Fall Timings

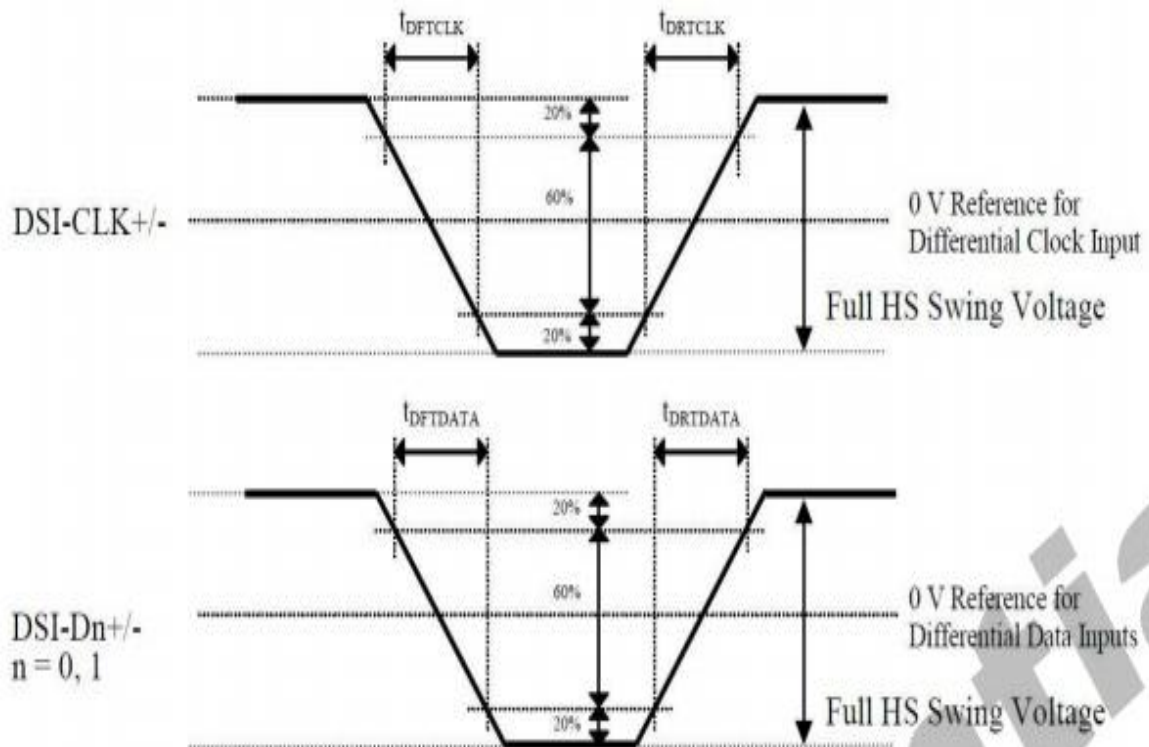


Figure 116 Rise and Fall Timings on Clock and Data Channels

Table 47 Rise and Fall Timings on Clock and Data Channels

Parameter	Symbol	Condition	Specification			Unit
			Min	Typ	Max	
Differential Rise Time for Clock	t_{DRTCLK}	DSI-CLK+/-	-	-	150 (Note)	ps
Differential Rise Time for Data	$t_{DRTDATA}$	DSI-Dn+/- n=0 and 1	-	-	150 (Note)	ps
Differential Fall Time for Clock	t_{DFTCLK}	DSI-CLK+/-	-	-	150 (Note)	ps
Differential Fall Time for Data	$t_{DFTDATA}$	DSI-Dn+/- n=0 and 1	-	-	150 (Note)	ps

Note: The display module has to meet timing requirements, what are defined for the transmitter (MPU) on MIPI D-Phy standard.



5. OPTICAL CHARACTERISTICS (LCD MONOMER PARAMETERS)

Item	Symbol	Conditions	Specifications			Unit	Note	
			Min.	Typ.	Max.			
Transmittance (w/o DBEF)	T%	Viewing normal angle $\theta_x = \theta_y = 0^\circ$	2.9	3.4	--	%	All left side data are based on INX's following condition – 1.LC : AAS . 2.CF : CG 70% CF. 3.Light Source : INX LED BLU. 4.Polarizer : CF SRW062APN1-HC5 / TFT SRW062APN1. 5.Machine : DMS 803, (ConoScope for View Angle). 6. VLC dark ≤ 0.2 V, VLC white ≥ 4.7 V	
Contrast Ratio	CR		600	1000	--	--		
Response Time	$T_{on} + T_{off}$	-	25	35	ms			
Viewing Angle	Hor.	θ_{x+}	--	80	--	deg.		
		θ_{x-}	--	80	--			
	Ver.	θ_{y+}	--	80	--			
		θ_{y-}	--	80	--			
CF only Color Chromaticity (CIE 1931)	Red	Rx	0.641	0.661	0.681	-		Under C light (CIE 1931)
		Ry	0.306	0.326	0.346	-		
	Green	Gx	0.257	0.277	0.297	-		
		Gy	0.550	0.570	0.590	-		
	Blue	Bx	0.125	0.145	0.165	-		
		By	0.057	0.077	0.097	-		
	White	Wx	0.290	0.310	0.330	-		
		Wy	0.314	0.334	0.354	-		
Color Gamut	CG	--	70%	--	%			

***Note(1) Definition of Contrast Ratio (CR):**

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

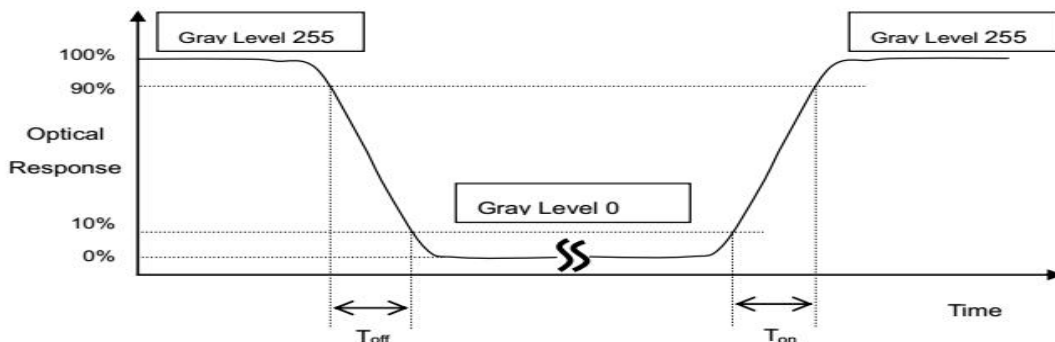
L255 : Luminance of gray level 255

L 0: Luminance of gray level 0

$$CR = CR (5)$$

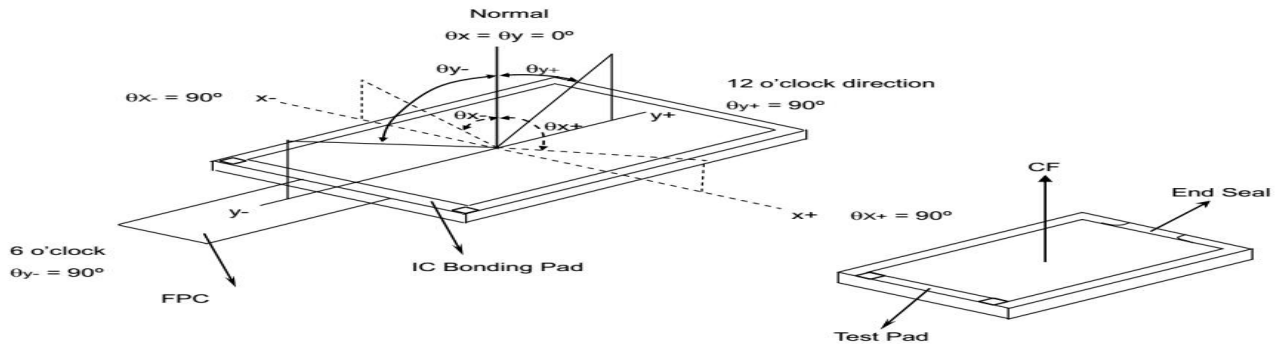
CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (5).

***Note (2) Definition of Response Time (T_{on} , T_{off}):**



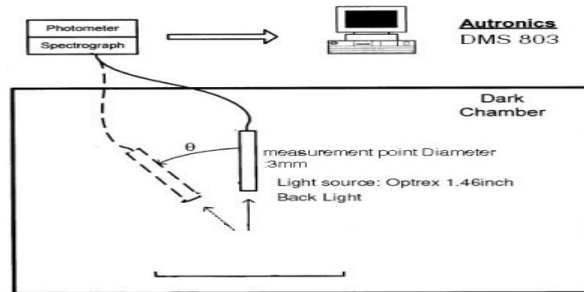


*Note(3) Definition of Viewing Angle

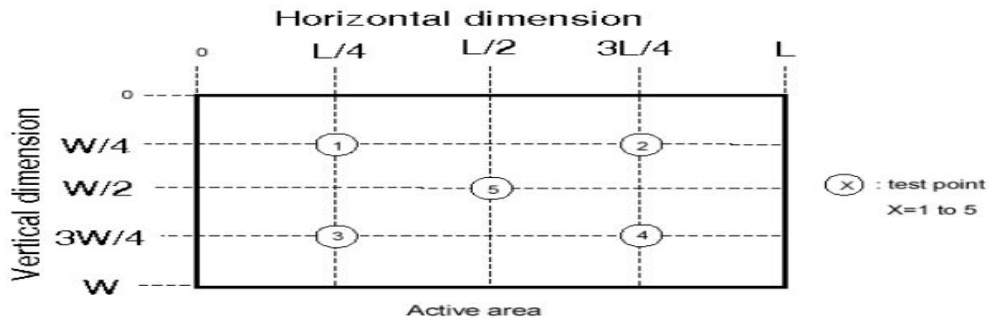


*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



*Note (5)



No.	Test Item	Test Condition	Check Time
1	High Temp Storage	Ta= 80°C	240 hrs
2	Low Temp Storage	Ta= -30°C	240 hrs
3	High Temp Operation	Ta= 70°C	240 hrs
4	Low Temp Operation	Ta= -20°C	240 hrs
5	High Temp & High Humidity Operation	Ta=60°C H=90%	240 hrs

Note:(1) Ta : Ambient temperature

(2) All judgments of display are performed after temp of panel returns to room temperature

(3) Display function should be no change under normal operating condition.

(4) Under no condensation of dew



6. QUALITY SPECIFICATIONS

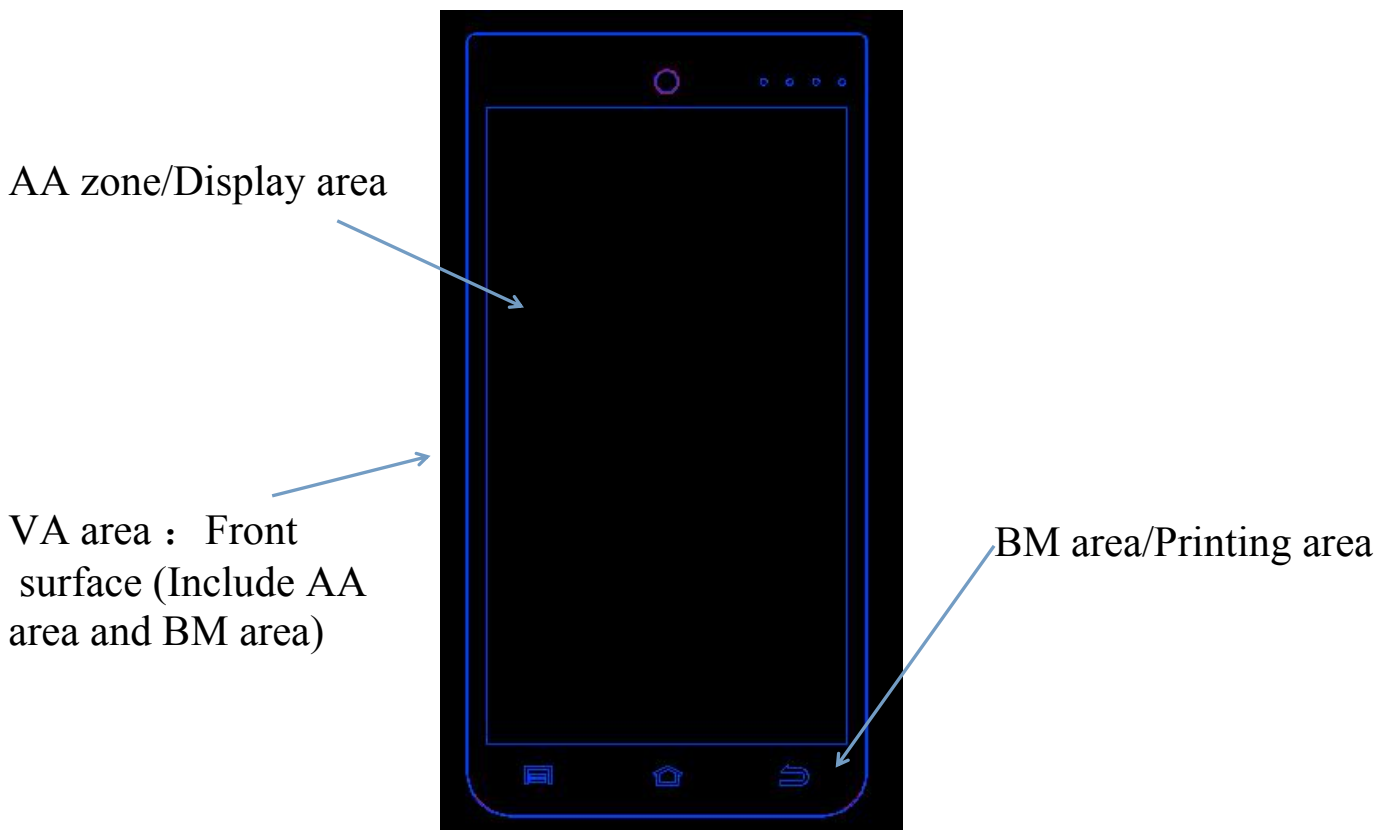
1. Inspection condition

1.1:Cosmetic inspection: viewing distance is about 30cm with bare eyes, and under an environment of 20~40W light intensity (600~1200LUX) , all directions for inspecting the sample should be within 45° against perpendicular line.

6.1.2:Function inspection: viewing distance is about 30cm with bare eyes, and under an environment of 300LUX light intensity, all directions for inspecting the sample should be within 45° against perpendicular line.

2. Definition of Inspection Item.

2.1 Definition of Inspection zone in I-touch module.



AA zone: Character/Display area

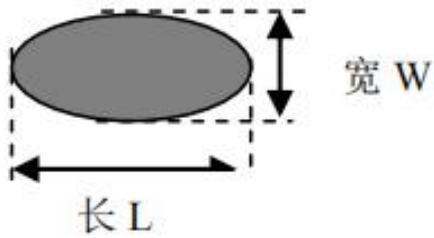
BM zone: Printing area

VA zone: Viewing area (AA area + BM area = viewing area)

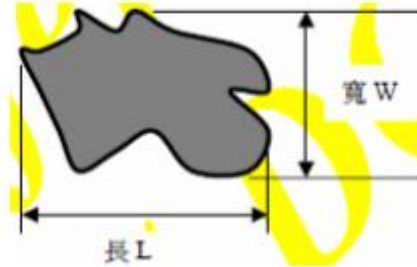


3. Defect definition

3.1 Circular defect

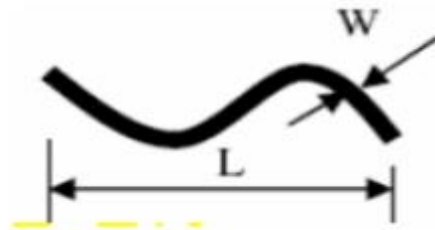


Diameter $\Phi = 1/2(L+W)$

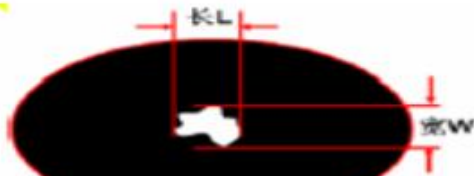


Diameter $\Phi = 1/2(L+W)$

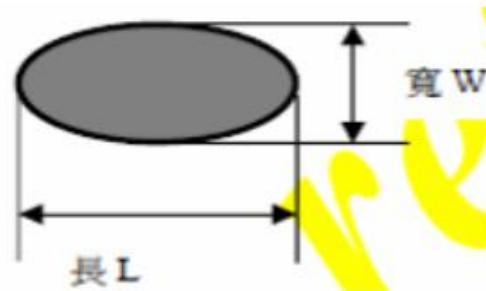
3.2 Linear defect



3.3 Pin hole



直径D(Diameter) = $1/2(L+W)$





3.4 Zigzag





4. Inspection standards

4.1 Major defect

-Item -No	Items to be inspected	Inspection Standard	Classification of defects
4.1.1	All 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) Touch panel abnormal.	Major
4.1.2	Missing	Missing component	
4.1.3	Outline dimension	Overall outline dimension beyond the drawing is not allowed.	
4.1.4	LCD Mura	LCD Mura according to ND 5% keep out to determine, if keep out distance at 30cm be seen by eyes is NG, otherwise will be ok if invisible.	
4.1.5	Sub Pixel classification	<ul style="list-style-type: none"> ● Sub Pixel: Number of sub pixel doesn't exceed two dot. <div style="text-align: center;">  <p>Sub Pixel (Dot)</p> </div> <p>a> Dark dot ----two Allowed b> Bright dot ---- two Allowed</p> ● Pixel : Three dots link together doesn't exceed twos <div style="text-align: center;">  <p>Pixel</p> </div> 	N ≤ 2



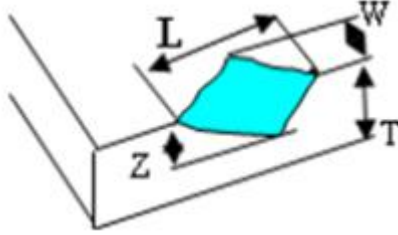
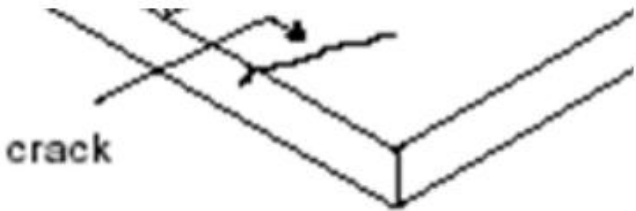
4.2 Cosmetic defect

Item No	Items to be inspected	Inspection Standard		Classification of defects
4.2.1	Dot defect	Zone Size(mm)	VA area	Minor
			Acceptable Qty	
		$\Phi \leq 0.1$	Ignore	
		$0.10 < \Phi \leq 0.25$	2	
		$0.25 < \Phi \leq 0.30$	1	
		$0.30 < \Phi$	0	
4.2.2	Dim Spots: Circle shaped and dim edged defects	Zone Size(mm)	VA area	Minor
			Acceptable Qty	
		$\Phi \leq 0.20$	Ignore	
		$0.20 < \Phi \leq 0.40$	2	
		$0.40 < \Phi \leq 0.60$	1	
		$0.60 < \Phi$	0	
Item No	Items to be inspected	Inspection Standard		Classification of defects
4.2.3	Dent Spot Fish eye	Zone Size(mm)	VA area	Minor
			Acceptable Qty	
		$\Phi \leq 0.10$	Ignore	
		$0.10 < \Phi \leq 0.20$	2	
		$0.20 < \Phi \leq 0.30$	1	
		$0.30 < \Phi$	0	





4.2.4	Line defect	Zone		VA area	Minor
		Size(mm)			
		L (Length)	W (Width)	Acceptable Qty	
		Ignore	$W \leq 0.03$	Ignore	
		$L \leq 5.0$	$0.03 < W \leq 0.05$	2	
		$L \leq 3.0$	$0.05 < W \leq 0.07$	1	
/	$0.07 < W$	Define as spot defect			
4.2.5	Scratch	<p>If the scratch can be seen after mobile phone cover assembling or in the operating condition, judged as the line defect of 4.2.4.</p> <p>If the scratch can be seen only in non-operating condition or some special angle, judged as the following table.</p>			Minor
		Size (mm)		VA area	
		L (Length)	Acceptable Qty	Acceptable Qty	
		Ignore	$W \leq 0.03$	Ignore	
		$5.0 < L \leq 10.0$	$0.03 < W \leq 0.05$	2	
		$L \leq 5.0$	$0.05 < W \leq 0.08$	1	
		/	$W > 0.08$	0	




Item No	Items to be inspected	Inspection Standard	Classification of defect										
4.2.6	Bubble	<table border="1"> <thead> <tr> <th data-bbox="488 405 852 477">Zone</th> <th data-bbox="855 405 1219 477">VA area</th> </tr> <tr> <th data-bbox="488 481 852 533">Size(mm)</th> <th data-bbox="855 481 1219 533">Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td data-bbox="488 537 852 589">$\Phi \leq 0.15$</td> <td data-bbox="855 537 1219 589">Ignore</td> </tr> <tr> <td data-bbox="488 593 852 645">$0.15 < \Phi \leq 0.25$</td> <td data-bbox="855 593 1219 645">2</td> </tr> <tr> <td data-bbox="488 649 852 701">$0.25 < \Phi$</td> <td data-bbox="855 649 1219 701">0</td> </tr> </tbody> </table>	Zone	VA area	Size(mm)	Acceptable Qty	$\Phi \leq 0.15$	Ignore	$0.15 < \Phi \leq 0.25$	2	$0.25 < \Phi$	0	
Zone	VA area												
Size(mm)	Acceptable Qty												
$\Phi \leq 0.15$	Ignore												
$0.15 < \Phi \leq 0.25$	2												
$0.25 < \Phi$	0												
4.2.7	Glass defect	<p data-bbox="488 779 906 815">4.2.7a Chip on corner or surface</p>  <table border="1" data-bbox="488 1137 1209 1294"> <thead> <tr> <th data-bbox="488 1144 730 1211">L(length)</th> <th data-bbox="734 1144 970 1211">W(width)</th> <th data-bbox="973 1144 1209 1211">Z(thickness)</th> </tr> </thead> <tbody> <tr> <td data-bbox="488 1216 730 1283">$L \leq 0.30$</td> <td data-bbox="734 1216 970 1283">$W \leq 0.20$</td> <td data-bbox="973 1216 1209 1283">T/2</td> </tr> </tbody> </table> <p data-bbox="488 1373 1136 1451">Notes: T=Lens thickness, $\Phi \leq 0.10$ ignore Acceptable Qty: Single edge $N \leq 2$, Total $N \leq 4$</p> <p data-bbox="488 1552 1011 1619">4.2.7b Cracks Cracks tend to break are not allowed.</p> 	L(length)	W(width)	Z(thickness)	$L \leq 0.30$	$W \leq 0.20$	T/2	Minor				
L(length)	W(width)	Z(thickness)											
$L \leq 0.30$	$W \leq 0.20$	T/2											



Item No	Items to be inspected	Inspection Standard	Classification of defect
4.2.8	Parts alignment	1) Not allow IC and FPC/heat-seal lead width is more than 50% beyond lead pattern. 2) Not allow chip or solder component is off center more than 50% of the pad outline.	Minor
4.2.9 view area/ printing area of front surface and view area of rear surface	LOGO Pattern	 <p>Dot: according to Dot spec. Thickness odds:</p> $\frac{ \text{Spec pattern width} - \text{Print pattern width} \times 100\%}{\text{Spec pattern width}} \leq 30\%$ <p>Drawing slant:</p> <p>Print pattern length $\leq 10\text{mm}$, slant angle $\leq 3^\circ$; $10\text{mm} < \text{Print pattern length} \leq 20\text{mm}$, slant angle $\leq 1.5^\circ$</p>  <p>Pattern serration: $H \leq 0.05 \text{ mm}$</p> <p>Pattern leak print/ error/overprint: not allowed</p> <p>Pattern break line: width $\leq 0.10 \text{ mm}$</p> <p>Logo pattern color windage / color thin: Follow the limit samples.</p>	Minor



Item No	Items to be inspected	Inspection Standard	Classification of defects
4.2.10 view area/print ing area of front surface and view area of rear surface	IR hole(A)/ Light sensor hole(B)/ LED hole(C)	 <ol style="list-style-type: none"> 1. A.B.C hole must be according the transmittancy 2. Light leakage on A.B.C hole or follow the limited sample. 3. A.B.C hole (LED) hole only judge by black background, no need to check in the lamb condition. 	Minor
	Surface dirty	<ol style="list-style-type: none"> 1. Dirty can not be cleaned follow the dot spec. 2. Accept while the dirty can be cleaned. 3. The quality guarantee period of protective film is 3months, during the period, the spot or contamination is not allowed. 	
	Printing area Light leakage	Follow the dot defect spec, MAX, Severity - see light leakage limit sample	
	Ink overflow	Visual inspection 30cm not allowed	
	Color discordant	Obvious color difference in the BM area is not allowed	
	Icon scratch of printing logo area	Icon printing logo area is not allow penetrability scratch	



7.RELIABILITY

Test Item	Test Condition	Inspection after test
High Temperature Operation	70°C for 96 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 试验结束后, 已测试的 LCD 样品必须在室内正常温湿度环境下放置 2~4 个小时以上才能进行功能和外观检查, 样品不允许有以下缺陷: 1. 无功能不良, 例: 缺划, 显异, 严重爆灯等 2. 外观无偏光片气泡, OCA 气泡等不良: 2. The test samples should be applied to only one test item. 每个被测试的模块只能用于其中的一个测试项目。
Low Temperature Operation	-20°C for 96 hours	
High Temperature Storage	80°C for 96 hours	
Low Temperature Storage	-30°C for 96 hours	
High Temperature Operation Humidity Operation	60°C, 90%RH for 72 hours	
Thermal Shock	-10°C (30min) ~+25°C (5min)- +60°C (30min) for 10 cycles	
Vibration Test (No Operation)	Frequency: 10~55Hz Amplitude:1.0mm Sweep Time: 11min Test Period: 6 Cycles for each direction of X, Y, Z	
Static electricity test	Touch ±4KV, air touch ±8KV	



8. HANDLING PRECAUTION

8.1 SAFETY

- (1) Do not swallow any liquid crystal, even if there is no proof that liquid crystal is poisonous.
- (2) If the LCD panel breaks, be careful not to get liquid crystal to touch your skin.
- (3) If skin is exposed to liquid crystal, wash the area thoroughly with alcohol or soap.

8.2 STORAGE CONDITIONS

- (1) Store the panel or module in a dark place where the temperature is $23\pm 5^{\circ}\text{C}$ and the humidity is below $50\pm 20\% \text{RH}$.
- (2) Store in anti-static electricity container.
- (3) Store in clean environment, free from dust, active gas, and solvent.
- (4) Do not place the module near organics solvents or corrosive gases.
- (5) Do not crush, shake, or jolt the module.

8.3 HANDLING PRECAUTIONS

- (1) Avoid static electricity which can damage the CMOS LSI.
- (2) The polarizing plate of the display is very fragile. So, please handle it very carefully.
- (3) Do not give external shock.
- (4) Do not apply excessive force on the surface.
- (5) Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
- (6) Do not use ketonic solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.
- (7) Do not operate it above the absolute maximum rating.
- (8) Do not remove the panel or frame from the module.

8.4 WARRANTY

- 1) Under normal use and storage conditions, it is within 12 months from the date of delivery. 在正常使用和储存条件下, 自交货之日起12个月内。
- 2) According to Kingtech TFT LCD quality standard, Kingtech will rework or exchange for functional defect goods sine within one year. 依据Kingtech TFT LCD质量标准, Kingtech将在一年内保修或置换功能缺陷产品。
- 3) strictly prohibit the display in the whole machine for a long time point a fixed screen (display by the LCD residual shadow determination criteria); suggest that the entire machine more than 2 minutes without the use of LCM automatically into hibernation, more than 30 minutes without the use of the system to force LCM into hibernation. 严禁显示屏在整机长期点一个固定画面(显示屏依LCD残影判定标准); 建议整机超过2分钟不使用LCM自动进入休眠, 超过30分钟不使用系统强制LCM进入休眠



状态。

- 4) Display is strictly prohibited to work continuously for more than 8 hours on the whole machine. 严禁显示屏在整机连续工作8小时以上。
- 5) Please take the module under static protection. 请在有静电防护情况下，拿取模组。
- 6) LCM in special scenarios (such as high concentration of chemicals, strong magnetic field, extreme cold, and other use scenarios) use in advance to contact us to confirm. LCM在特殊场景（比如高浓度化学品，强磁场，极寒等使用场景）使用时提前联系我们确认。

9. Packing specification

TBD