



**SPECIFICATION  
FOR  
LCD Module  
TS8028WV001-T**

<b>MODULE:</b>	<b>TS8028WV001-T</b>
<b>CUSTOMER:</b>	

<b>TZD</b>	<b>INITIAL</b>	<b>DATE</b>
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<b>APPROVED BY</b>	罗教平	20221014

<b>CUSTOMER</b>	<b>INITIAL</b>	<b>DATE</b>
<b>APPROVED BY</b>		



## REVISION STATUS

Version	Revise Date	Page	Content	Modified by
V1.0	20221014	-	First Issued.	YANG
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## 1. General Description

### \* DESCRIPTION

TS8028WV001-T 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 2.8" TFT-LCD contains 480\*480 pixels, and can display up to 16.7M colors.

### \* Features

- Low Input Voltage: VDD: 2.7~3.6V;
- Display Colors of TFT LCD: 16.7M colors
- CPU Interface: -MIPI
- Internal Power Supply Circuit.

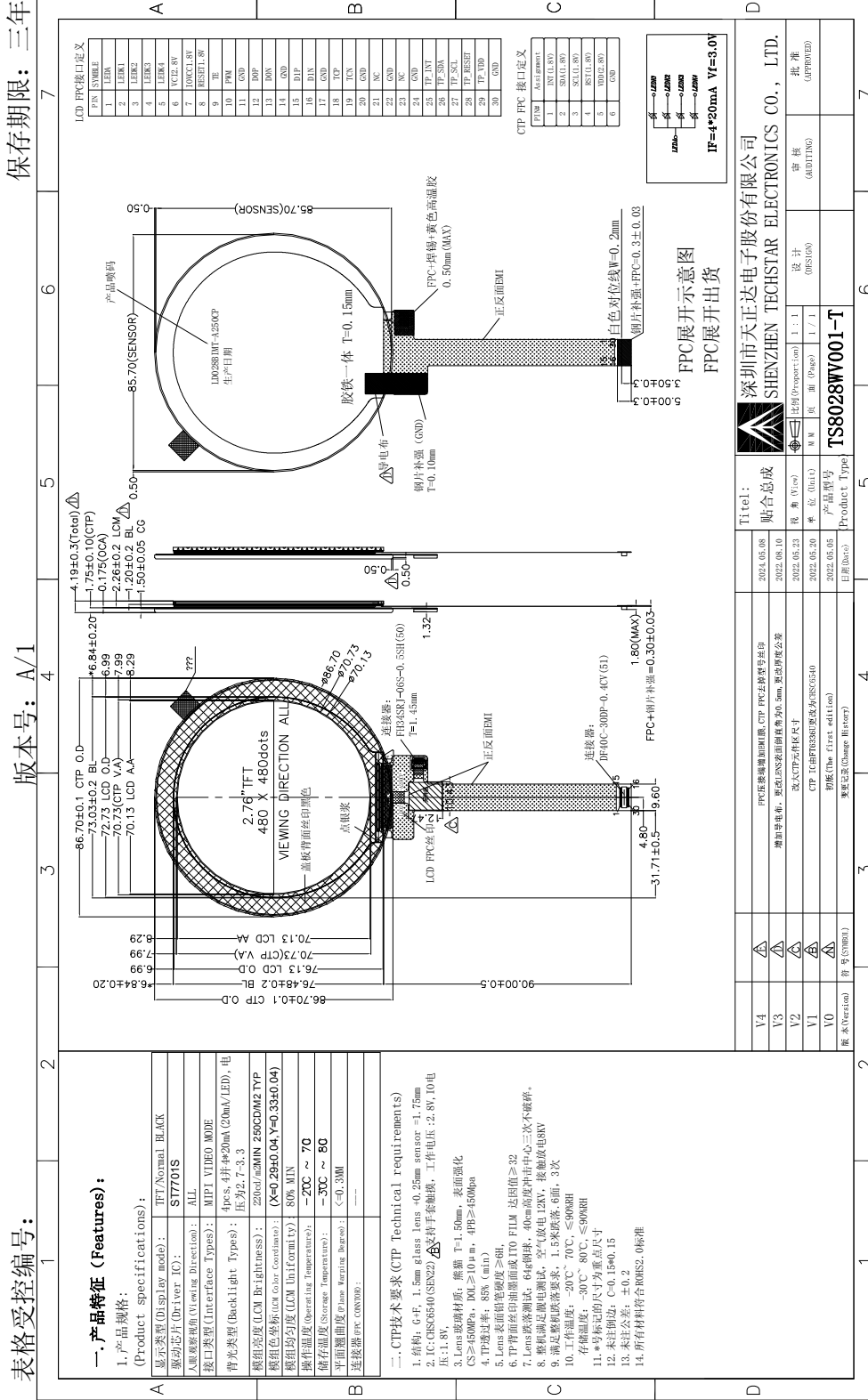
General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	70.128(H) *70.128(V) (2.8inch )	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	16.7M	colors	-
Number of pixels	480(RGB) *480	dots	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.180(H) *0.180(V)	mm	-
Viewing angle	ALL	o'clock	-
Drive IC	ST7701S	-	-
Color Pixel Arrangement	RGB vertical stripe		
Display mode	Transmissive/ Normally Black	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

### Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	86.7	-	mm	-0.1
	Vertical(V)	-	86.7	-	mm	-0.1
	Depth(D)	-	4.19	-	mm	±0.3
Weight		-	TBD	-	g	-



## 2. Mechanical Specification





### 3. PIN DESCRIPTION

Pin NO.	Symbol	Level	Function
1	LEDA	H	Backlight+
2	LEDK1	L	Backlight-
3	LEDK2	L	Backlight-
4	LEDK3	L	Backlight-
5	LEDK4	L	Backlight-
6	VDD 2.8V	H	Power supply(2.5-3.3V)
7	IOVCC1.8V	H	Power supply(1.65-3.3V)
8	LCM RST	H/L	LCM Hardware reset pin
9	TE	H/L	Tearing effect output
10	PWM	H/L	Backlight on/off control pin.
11	GND	L	Ground
12	D0P	H/L	HSSI_D0+ are differential data signal line.
13	D0N	H/L	HSSI_D0- are differential data signal line.
14	GND	L	Ground
15	D1P	H/L	HSSI_D1+ are differential data signal line.
16	D1N	H/L	HSSI_D1- are differential data signal line.
17	GND	L	Ground
18	CP	H/L	HSSI_CLK+ are differential data signal line.
19	CN	H/L	HSSI_CLK- are differential data signal line.
20	GND	L	Ground
21	NC		NC
22	GND	L	Ground
23	NC		NC
24	GND	L	Ground
25	TP-INT	H/L	Interrupt pin
26	TP-SDA	H/L	Serial data input pin
27	TP-SCL	H/L	Serial clock input
28	TP-REST	H/L	TP Hardware reset pin
29	TP-VCC	H/L	Power supply 2.8V
30	GND	L	Ground



## 4. ELECTRICAL CHARACTERISTICS

### 4.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Values		Unit	Remark
		Min	Max.		
Supply Voltage for Logic circuit	IOVCC	-0.3	4.6	V	
Supply Voltage for analog circuit	VCI	-0.3	4.6	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	2.7	2.8	3.3	V	
Normal mode Current consumption	I <sub>cc</sub>	-	-	55	mA	V <sub>cc</sub> =2.8V
TFT Gate ON Voltage	V <sub>GH</sub>	11.5	12	16	V	
TFT Gate OFF Voltage	V <sub>GL</sub>	-8	-12	-12	V	

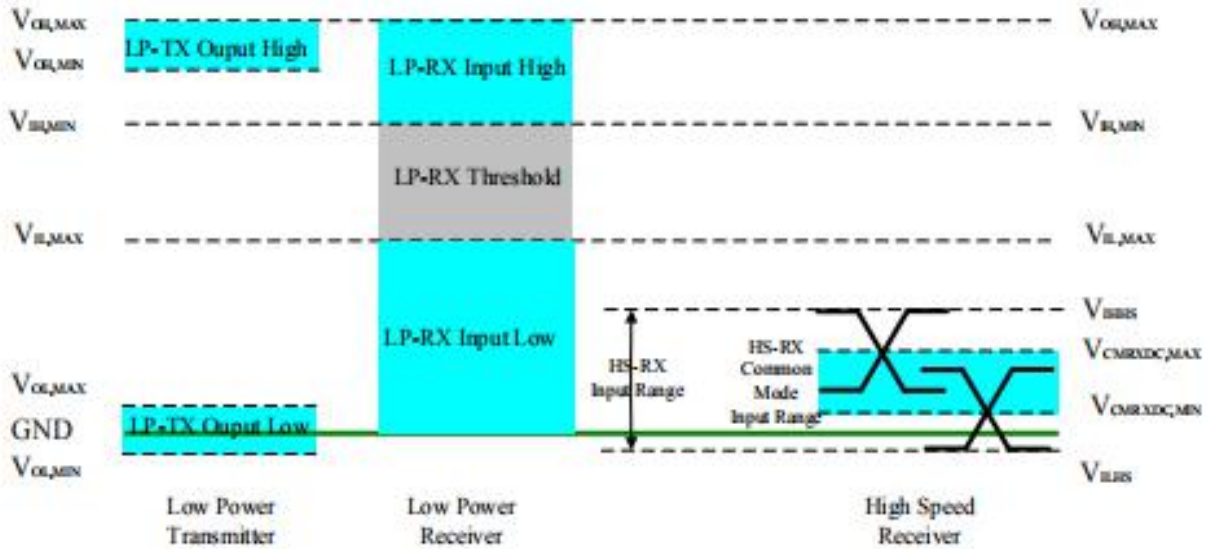
#### 4.2.2 BACKLIGHT UNIT (GND=0V)

Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
Forward supply Voltage	V <sub>f</sub>	2.7	-	3.3	V	
Forward supply Current	I <sub>f</sub>	-	80	-	mA	
LCM Luminance	L <sub>v</sub>	220	250	-	cd/m <sup>2</sup>	I <sub>B</sub> =80mA
Uniformity	/	80			%	-



## 4.3 MIPI TIMING CHARACTERISTICS

### 7.3 DC Characteristics



$V_{DD1}=1.8, V_{DD}=2.8, AGND=DGND=0V, T_0=25\text{ }^{\circ}\text{C}$

Parameter	Symbol	Specification			Unit
		MIN	TYP	MAX	
Operation Voltage for MIPI Receiver					
Low power mode operating voltage	$V_{LPH}$	1.1	1.2	1.3	V
MIPI Characteristics for High Speed Receiver					
Single-ended input low voltage	$V_{LHS}$	-40	-	-	mV
Single-ended input high voltage	$V_{IHS}$	-	-	460	mV
Common-mode voltage	$V_{CM,DC}$	70	-	330	mV
Differential input impedance	$Z_{ID}$	80	100	125	ohm
MIPI Characteristics for Low Power Mode					
Pad signal voltage range	$V_I$	-50	-	1350	mV
Logic 0 input threshold	$V_{IL}$	0-	-	550	mV
Logic 1 input threshold	$V_{IH}$	880	-	1350	mV
Output low level	$V_{OL}$	-50	-	50	mV
Output high level	$V_{OH}$	1.1	1.2	1.3	V





**7.5.4.1 High Speed Mode**



**Figure 4 DSI clock channel timing**

**Figure 5 Rising and falling time on clock and data channel**

*VDDI=1.8, VDD=2.8, AGND=DGND=0V, Ta=25 °C*

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
DSI-CLK+/-	$2xU_{INSTA}$	Double UI instantaneous	4	25	ns	
DSI-CLK+/-	$U_{INSTA}$ $U_{INSTB}$	UI instantaneous halves	2	12.5	ns	$UI = U_{INSTA} = U_{INSTB}$
DSI-Dn+/-	tDS	Data to clock setup time	0.15	-	UI	
DSI-Dn+/-	tDH	Data to clock hold time	0.15	-	UI	

**Table 7 Mipi Interface- High Speed Mode Timing Characteristics**



7.5.4.2 Low Power Mode

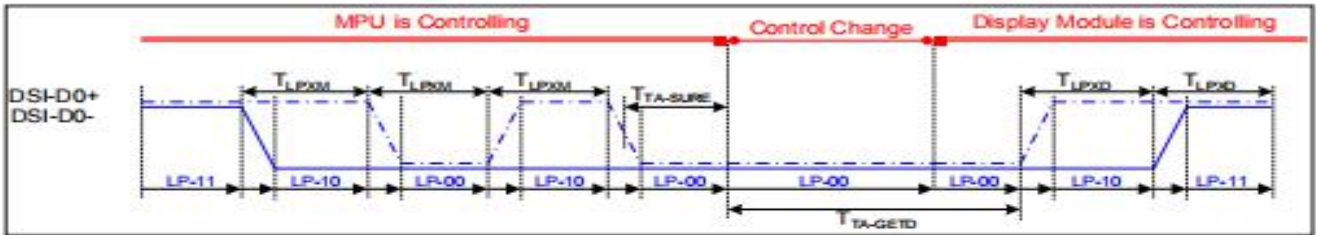


Figure 6 Bus Turnaround (BTA) from display module to MPU Timing

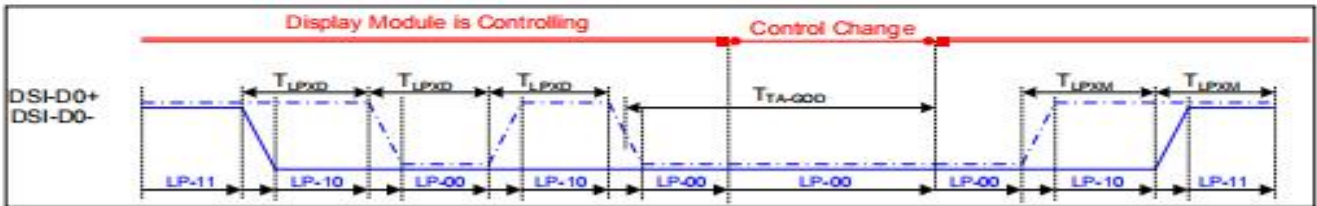


Figure 7 Bus Turnaround (BTA) from MPU to display module Timing

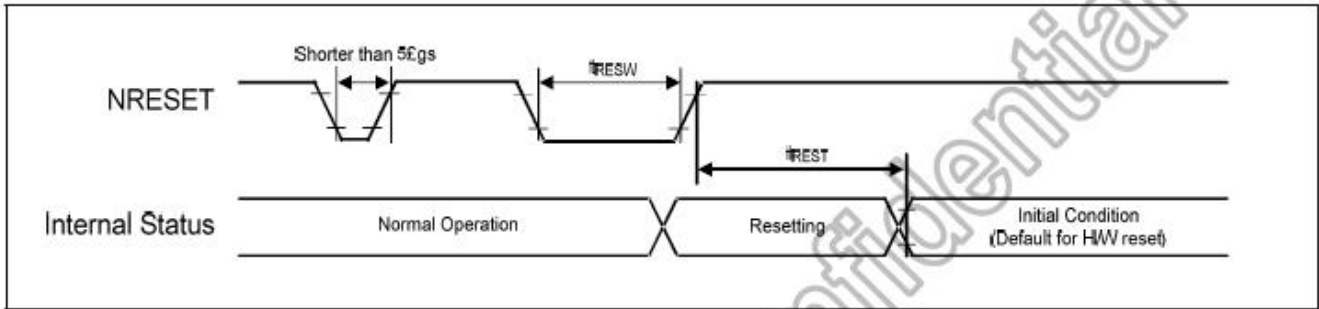
*VDD1=1.8, VDD=2.8, AGND=DGND=0V; T<sub>a</sub>=25 °C*

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
DSI-D0+/-	TLPXM	Length of LP-00,LP-01, LP-10 or LP-11 periods MPU→Display Module	50	75	ns	Input
DSI-D0+/-	TLPXD	Length of LP-00,LP-01, LP-10 or LP-11 periods MPU→Display Module	50	75	ns	Output
DSI-D0+/-	TTA-SURED	Time-out before the MPU start driving	T <sub>LPXD</sub>	2xT <sub>LPXD</sub>	ns	Output
DSI-D0+/-	TTA-GETD	Time to drive LP-00 by display module	5xT <sub>LPXD</sub>		ns	Input
DSI-D0+/-	TTA-GOD	Time to drive LP-00 after turnaround request-MPU	4xT <sub>LPXD</sub>		ns	Output

Table 8 Mipi Interface Low Power Mode Timing Characteristics



### 4.3.2. Reset input timing

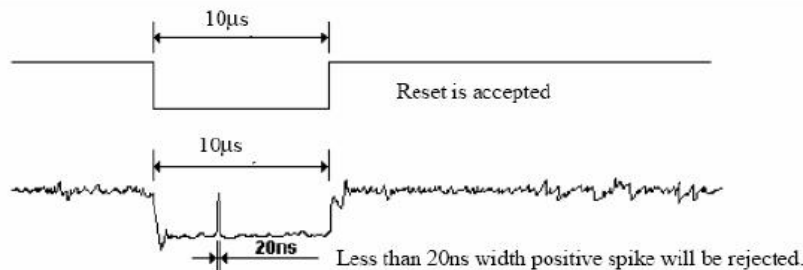


Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
tRESW	Reset low pulse width <sup>(1)</sup>	NRESET	10	-	-	-	µs
tREST	Reset complete time <sup>(2)</sup>	-	5	-	-	When reset applied during SLPIN mode	ms
		-	120	-	-	When reset applied during SLP0UT mode	ms

**Note:** (1) Spike due to an electrostatic discharge on NRESET line does not cause irregular system reset according to the following table.

NRESET Pulse	Action
Shorter than 5 µs	Reset Rejected
Longer than 10 µs	Reset
Between 5 µs and 10 µs	Reset Start

- (2) During the resetting period, the display will be blanked (The display is entering blanking sequence, which Maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode) and then return to Default condition for H/W reset.
- (3) During Reset Complete Time, ID and VCOM value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of NRESET.
- (4) Spike Rejection also applies during a valid reset pulse as shown as below:



- (5) It is necessary to wait 5msec after releasing NRESET before sending commands. Also Sleep Out command cannot be sent for 120msec.





## 5. OPTICAL CHARACTERISTICS

(LCD optical characteristics)

The test of view angle range shall be measured in a dark room (ambient luminance  $\leq 1$  lux and temperature =  $25 \pm 2^\circ\text{C}$ ) with the equipment of Luminance meter system (Gonio meter system and TOPCON CS2000/CA310) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of  $\theta$  and  $\phi$  equal to  $0^\circ$ . We refer to  $\theta\phi=0$  ( $=\theta_3$ ) as the 3 o'clock direction (the "right"),  $\theta\phi=90$  ( $=\theta_{12}$ ) as the 12 o'clock direction ("upward"),  $\theta\phi=180$  ( $=\theta_9$ ) as the 9 o'clock direction ("left") and  $\theta\phi=270$  ( $=\theta_6$ ) as the 6 o'clock direction ("bottom"). While scanning  $\theta$  and/or  $\phi$ , the center of the measuring spot on the Display surface shall stay fixed. The luminance, color and uniformity (etc) should be tested by CS2000/CA310. The backlight should be operating for 10 minutes prior to measurement.

<Table 4. Optical Specifications>

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing Angle range	Horizontal	CR > 10	$\theta_3$	80	85	-	Deg.	Note 1
			$\theta_9$	80	85	-	Deg.	
	Vertical		$\theta_{12}$	80	85	-	Deg.	
			$\theta_6$	80	85	-	Deg.	
Contrast ratio	CR	$\theta = 0^\circ$	1000	1200	-	-	Note 2	
Transmittance	Tr		3.91	4.6	-	%	Note 3 @Silicate BLU POL:HC+Clear	
Color Gamut	NTSC	CIE1931	$\theta = 0^\circ$	60	65	-	%	Note 4 CF@C Light(Q-P anel)
Reproduction of color		Rx	$\theta = 0^\circ$	0.617	0.647	0.677		
		Ry		0.283	0.313	0.343		
		Gx		0.233	0.263	0.293		
		Gy		0.530	0.560	0.590		
		Bx		0.107	0.137	0.167		
		By		0.076	0.106	0.136		
	White	Wx		0.268	0.298	0.328	-	
Wy	0.297	0.327	0.357	-				
Response Time	Tr+Td	Ta= $25^\circ\text{C}$ $\theta = 0^\circ$	-	35	40	ms	Note 5	



Notes : 1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see FIGURE 1).

2. Contrast measurements shall be made at viewing angle of  $\Theta = 0$  and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (see FIGURE 1) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Transmittance is the Value with Polarizer(HC+Clear) & silicate BLU ( Film structure is on Table 5.1 ) .

4. The color chromaticity coordinates specified in Table 5. shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the CF and based on C Light

5. The electro-optical response time measurements shall be made as FIGURE 2. The times needed for the luminance to change from 10% to 90% is  $T_r$ , and 90% to 10% is  $T_f$ .



## 6. QUALITY SPECIFICATIONS

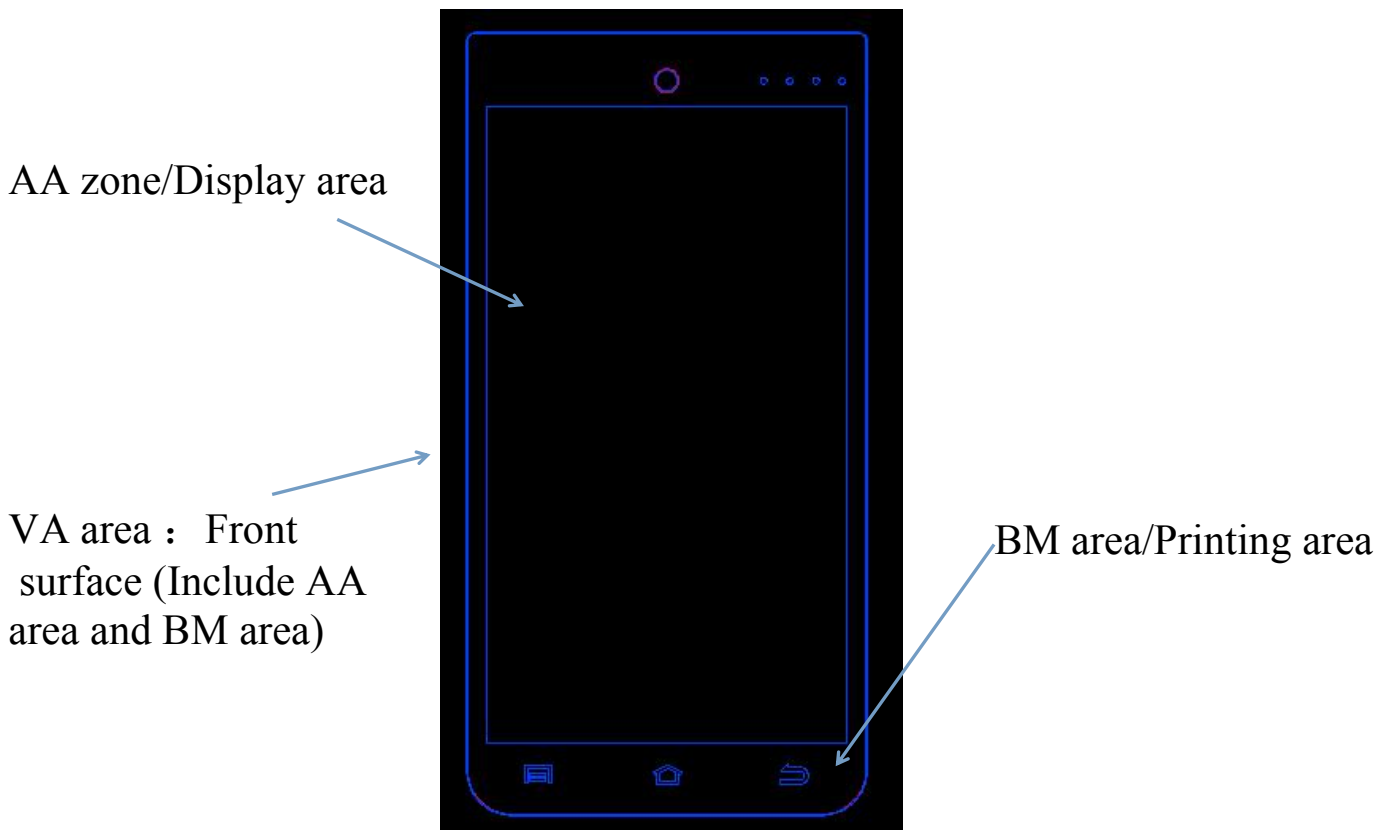
### 1. Inspection condition

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

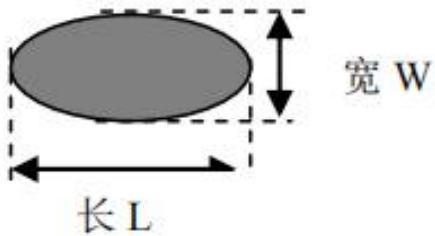
BM zone: Printing area

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

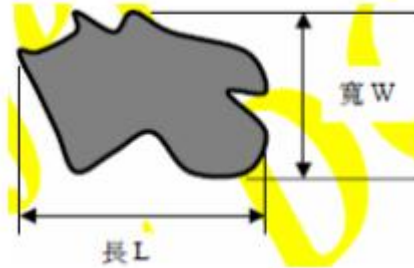


### 3. Defect definition

#### 3.1 Circular defect

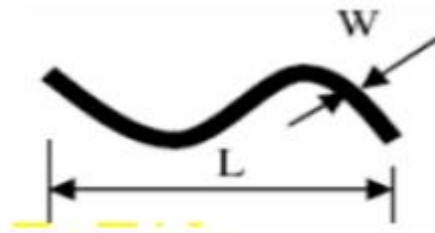


Diameter  $\Phi = 1/2(L+W)$

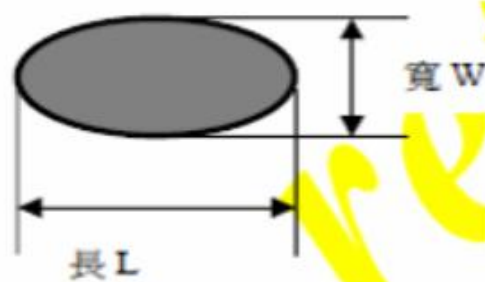
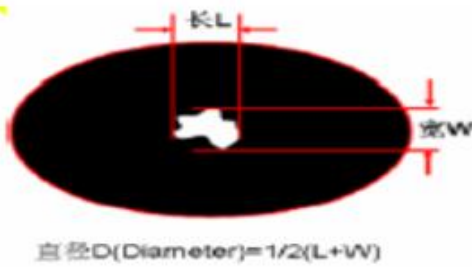


Diameter  $\Phi = 1/2(L+W)$

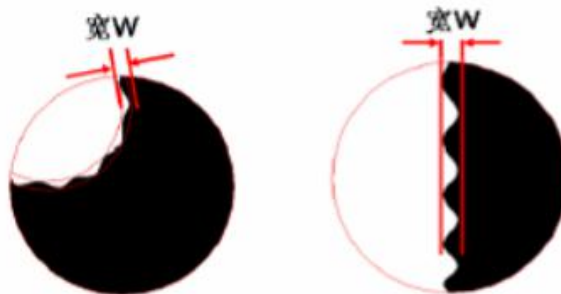
#### 3.2 Linear defect



#### 3.3 Pin hole



#### 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"> <li>● Sub Pixel: Number of sub pixel doesn't exceed two dot.   <p style="text-align: center;">Sub Pixel (Dot)</p> <p>a&gt; Dark dot ----two Allowed                b&gt; Bright dot ---- two Allowed</p> </li> <li>● Pixel : Three dots link together doesn't exceed twos   <p style="text-align: center;">Pixel</p> </li> </ul>	N ≤ 2





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#### 4.2 Cosmetic defect

Item No	Items to be inspected	Inspection Standard	Classification of defects										
4.2.1	Dot defect	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">Zone Size(mm)</th> <th style="width: 50%; text-align: center;">VA area Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.1</math></td> <td style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.10 &lt; \Phi \leq 0.25</math></td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;"><math>0.25 &lt; \Phi \leq 0.30</math></td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;"><math>0.30 &lt; \Phi</math></td> <td style="text-align: center;">0</td> </tr> </tbody> </table>	Zone Size(mm)	VA area 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	Minor
Zone Size(mm)	VA area 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	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">Zone Size(mm)</th> <th style="width: 50%; text-align: center;">VA area Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.20</math></td> <td style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.20 &lt; \Phi \leq 0.40</math></td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;"><math>0.40 &lt; \Phi \leq 0.60</math></td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;"><math>0.60 &lt; \Phi</math></td> <td style="text-align: center;">0</td> </tr> </tbody> </table>	Zone Size(mm)	VA area 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	Minor
Zone Size(mm)	VA area 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	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">Zone Size(mm)</th> <th style="width: 50%; text-align: center;">VA area Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.10</math></td> <td style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.10 &lt; \Phi \leq 0.20</math></td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;"><math>0.20 &lt; \Phi \leq 0.30</math></td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;"><math>0.30 &lt; \Phi</math></td> <td style="text-align: center;">0</td> </tr> </tbody> </table>	Zone Size(mm)	VA area 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	Minor
Zone Size(mm)	VA area 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		

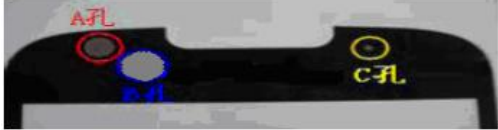


Item No	Items to be inspected	Inspection Standard	Classification of defect										
4.2.6	Bubble	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Zone Size(mm)</th> <th style="width: 50%;">VA area</th> </tr> <tr> <th></th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.15</math></td> <td style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.15 &lt; \Phi \leq 0.25</math></td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;"><math>0.25 &lt; \Phi</math></td> <td style="text-align: center;">0</td> </tr> </tbody> </table>	Zone Size(mm)	VA area		Acceptable Qty	$\Phi \leq 0.15$	Ignore	$0.15 < \Phi \leq 0.25$	2	$0.25 < \Phi$	0	
Zone Size(mm)	VA area												
	Acceptable Qty												
$\Phi \leq 0.15$	Ignore												
$0.15 < \Phi \leq 0.25$	2												
$0.25 < \Phi$	0												
4.2.7	Glass defect	<p>4.2.7a Chip on corner or surface</p> <div style="text-align: center;"> </div> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px auto;"> <thead> <tr> <th style="width: 33%;">L(length)</th> <th style="width: 33%;">W(width)</th> <th style="width: 33%;">Z(thickness)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>L \leq 0.30</math></td> <td style="text-align: center;"><math>W \leq 0.20</math></td> <td style="text-align: center;"><math>T/2</math></td> </tr> </tbody> </table> <p>Notes: T=Lens thickness, <math>\Phi \leq 0.10</math> ignore Acceptable Qty: Single edge <math>N \leq 2</math>, Total <math>N \leq 4</math></p> <p>4.2.7b Cracks Cracks tend to break are not allowed.</p> <div style="text-align: center;"> <p>crack</p> </div>	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><b>Dot: according to Dot spec.</b>  <b>Thickness odds:</b></p> $\frac{ \text{Spec pattern width} - \text{Print pattern width}  \times 100\%}{\text{Spec pattern width}} \leq 30\%$ <p><b>Drawing slant:</b></p> <p>Print pattern length <math>\leq 10\text{mm}</math>, slant angle <math>\leq 3^\circ</math> ;  <math>10\text{mm} &lt; \text{Print pattern length} \leq 20\text{mm}</math>, slant angle <math>\leq 1.5^\circ</math></p>  <p><b>Pattern serration:</b> <math>H \leq 0.05 \text{ mm}</math></p> <p><b>Pattern leak print/ error/overprint:</b> not allowed</p> <p><b>Pattern break line:</b> width <math>\leq 0.10 \text{ mm}</math></p> <p><b>Logo pattern color windage / color thin:</b> 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)	 <p>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.</p>	Minor
	Surface dirty	<p>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.</p>	
	Printing area Light leakage	<p>Follow the dot defect spec, MAX, Severity - see light leakage limit sample</p>	
	Ink overflow	<p>Visual inspection 30cm not allowed</p>	
	Color discordant	<p>Obvious color difference in the BM area is not allowed</p>	
	Icon scratch of printing logo area	<p>Icon printing logo area is not allow penetrability scratch</p>	



## 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 Techstar TFT LCD quality standard, Techstar will rework or exchange for functional defect goods since within one year. 依据Techstar TFT LCD质量标准, Techstar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。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。