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***PRODUCT : TFT TOUCH MODULE***

***MODULE NO. :***

***SUPPLIER:***

***DATE:***

# ***SPECIFICATION***

*Revision: 0.0*

*This module uses ROHS material*

*This specification may change without prior notice in order to improve performance or quality. Please contact WKS R&D department for updated specification and product status before design for this product or release of this order.*

<b><i>WRITTEN BY</i></b>	<b><i>CHECKED BY</i></b>	<b><i>APPROVED BY</i></b>

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## ***REVISION RECORD***

<b><i>REV NO.</i></b>	<b><i>REV DATE</i></b>	<b><i>CONTENTS</i></b>	<b><i>REMARKS</i></b>
<i>0.0</i>	<i>2022-10-22</i>	<i>First release</i>	<i>Preliminary</i>

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## 1、GENERAL INFORMATION

<i>Item of general information</i>	<i>Contents</i>	<i>Unit</i>
<i>LCD Display Size (Diagonal)</i>	<i>3.5</i>	<i>inch</i>
<i>LCD Display Type</i>	<i>TFT/TRANSMISSIVE</i>	<i>-</i>
<i>LCD Display Mode</i>	<i>Normally Black</i>	<i>-</i>
<i>Recommended Viewing Direction</i>	<i>ALL</i>	<i>-</i>
<i>Gray inversion Direction</i>	<i>-</i>	<i>-</i>
<i>Module size (W×H×T)</i>	<i>55.26×84.69×3.50</i>	<i>mm</i>
<i>Active area (W×H)</i>	<i>48.96×73.44</i>	<i>mm</i>
<i>Number of pixels (Resolution)</i>	<i>320RGB×480</i>	<i>pixel</i>
<i>Pixel pitch (W×H)</i>	<i>0.153×0.153</i>	<i>mm</i>
<i>Color Pixel Arrangement</i>	<i>RGB Stripe</i>	<i>-</i>
<i>LCD Driver IC</i>	<i>ST7796</i>	<i>-</i>
<i>Interface Type</i>	<i>8080 16bit Parallel interface</i>	<i>-</i>
<i>Color Numbers</i>	<i>65K</i>	<i>-</i>
<i>Backlight Type</i>	<i>White LED</i>	<i>-</i>

P.5



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### 3、ABSOLUTE MAXIMUM RATINGS

<i>Parameter of absolute maximum ratings</i>	<i>Symbol</i>	<i>Min</i>	<i>Max</i>	<i>Unit</i>
<i>LCD supply voltage</i>	<i>VCI</i>	-0.3	5.5	V
	<i>IOVCC</i>	-0.3	5.5	V
<i>Operating temperature</i>	<i>Top</i>	-20	70	°C
<i>Storage temperature</i>	<i>Tst</i>	-30	80	°C
<i>Humidity</i>	<i>RH</i>	-	90%(Max 60°C)	<i>RH</i>

*Note: Absolute maximum ratings mean the product can withstand short-term, not more than 120 hours. If the product is a long time to withstand these conditions, the life time would be shorter.*

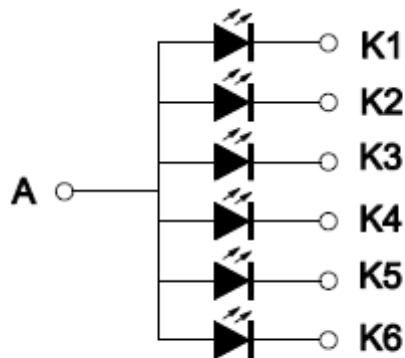
### 4、ELECTRICAL CHARACTERISTICS(DC CHARACTERISTICS)

<i>Parameter of DC characteristics</i>	<i>Symbol</i>	<i>Min.</i>	<i>Typ.</i>	<i>Max.</i>	<i>Unit</i>
<i>Analog operating voltage</i>	<i>VCI</i>	2.3	2.8	3.3	V
<i>I/O operating voltage</i>	<i>IOVCC</i>	1.65	1.8	3.3	V
<i>Input voltage ‘H’ level</i>	<i>VIH</i>	0.7* <i>IOVCC</i>	-	<i>IOVCC</i>	V
<i>Input voltage ‘L’ level</i>	<i>VIL</i>	VSS	-	0.2* <i>IOVCC</i>	V
<i>Output voltage ‘H’ level</i>	<i>VOH</i>	0.8* <i>IOVCC</i>	-	<i>IOVCC</i>	V
<i>Output voltage ‘L’ level</i>	<i>VOL</i>	VSS	-	0.2* <i>IOVCC</i>	V

## 5、BACKLIGHT CHARACTERISTICS

<i>Item of backlight characteristics</i>	<i>Symbol</i>	<i>Min.</i>	<i>Typ.</i>	<i>Max.</i>	<i>Unit</i>	<i>Remark</i>
<i>Forward voltage</i>	<i>V<sub>f</sub></i>	2.9	3.1	3.3	V	<i>Note1</i>
<i>Forward Current</i>	<i>I<sub>f</sub></i>	-	90	-	mA	
<i>Number of LED</i>	-	-	6	-	<i>Piece</i>	-
<i>LED Connection mode</i>	<i>P/S</i>	-	<i>Parallel</i>	-	-	-
<i>Lifetime of LED</i>	-	-	10000	-	<i>hour</i>	<i>Note2</i>

- *Note1: The LED Supply Voltage is defined by the number of LED at Ta=25°C and I<sub>f</sub>=90mA.*
- *Note2: The LED lifetime define as the estimated time to 50% degradation of initial luminous. The LED lifetime could be decreased if operating I<sub>f</sub> is larger than 120mA.*
- *Backlight circuit :*



## 6、ELECTRO-OPTICAL CHARACTERISTICS

Item of electro-optical characteristics		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	Note
Response time		Tr+Tf	$\theta=0$ $\phi=0$ Ta=25°C	-	25	35	ms	FIG 1.	4
Contrast Ratio		CR		-	800	-	-	FIG 2.	1
Luminance uniformity		$\delta WHITE$		-	80	-	%	FIG 2.	3
Surface Luminance		Lv		-	250	-	cd/m2	FIG 2.	2
CIE (x, y) chromaticity	White	White x	$\theta=0$ $\phi=0$ Ta=25°C	-	0.304	-	-	FIG 2.	5
		White y		-	0.332	-			
	Red	Red x		-	0.655	-			
		Red y		-	0.317	-			
	Green	Green x		-	0.262	-			
		Green y		-	0.568	-			
	Blue	Blue x		-	0.137	-			
		Blue y		-	0.085	-			
Viewing angle range	$\phi=90(12\text{ o'clock})$		CR ≥ 10	-	85	-	deg	FIG 3.	6
	$\phi=270(6\text{ o'clock})$			-	85	-	deg		
	$\phi=0(3\text{ o'clock})$			-	85	-	deg		
	$\phi=180(9\text{ o'clock})$			-	85	-	deg		
NTSC ratio		-	-	-	60	-	%	-	-

**Note 1.** Contrast Ratio(CR) is defined mathematically by the following formula. For more information see FIG 2.

$$\text{Contrast Ratio(CR)} = \frac{\text{Average Surface Luminance with all white pixels(P1,P2,P3,P4,P5,P6,P7,P8,P9)}}{\text{Average Surface Luminance with all black pixels(P1,P2,P3,P4,P5,P6,P7,P8,P9)}}$$

**Note 2.** Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

$$Lv = \text{Average Surface Luminance with all white pixels (P1,P2,P3,P4,P5,P6,P7,P8,P9)}$$

**Note 3.** The uniformity in surface luminance ( $\delta WHITE$ ) 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 2.

$$\delta_{\text{WHITE}} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5, P6, P7, P8, P9)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5, P6, P7, P8, P9)}}$$

**Note 4.** Response time is the time required for the display to transition from White to black(Rise Time,  $T_r$ ) and from black to white(Decay Time,  $T_f$ ). For additional information see FIG 1.

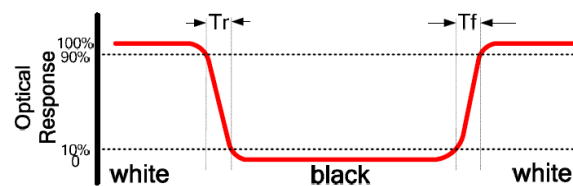
**Note 5.** CIE (x, y) chromaticity ,The x,y value is determined by screen active area position 5. For more information see FIG 2.

**Note 6.** Viewing angle is the angle at which the contrast ratio is greater than a specific value. For TFT module, the specific value of contrast ratio is 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.

**Note 7.** 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.

**Note 8.** For TN type TFT transmissive module, Gray scale reverse occurs in the direction of panel viewing angle.

**FIG.1. The definition of Response Time**



**FIG.2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity,**

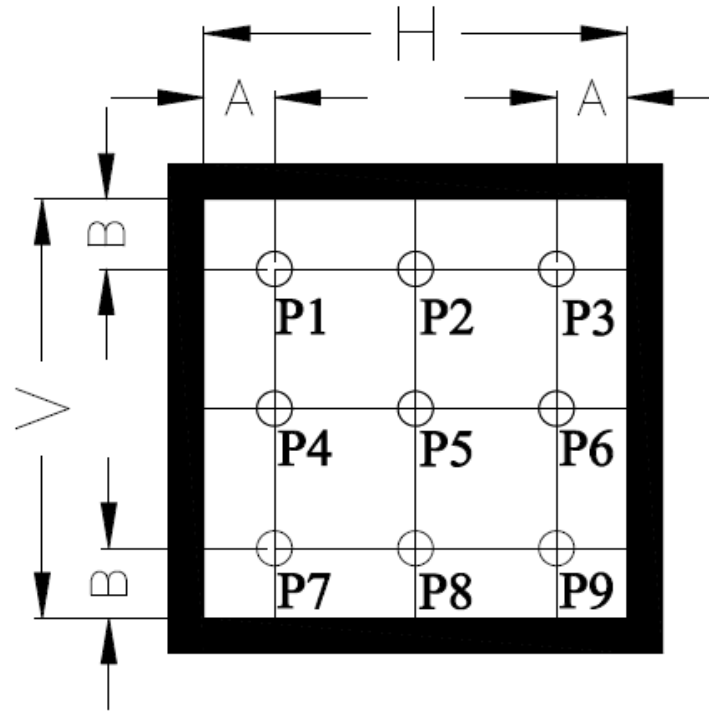
**CIE (x , y) chromaticity**

$A : H/6 ;$

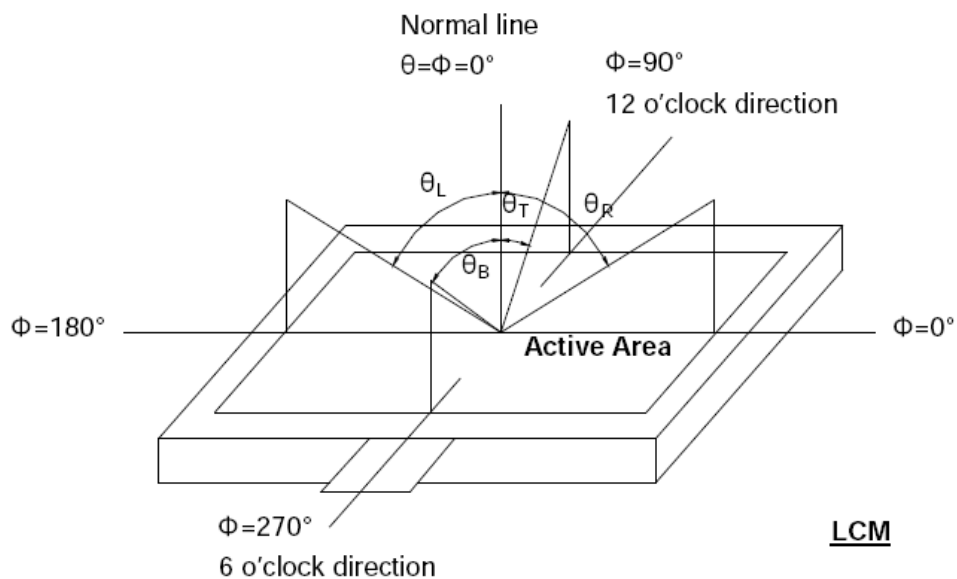
$B : V/6 ;$

$H, V : \text{Active Area(AA) size}$

Measurement instrument: BM-7; Light spot size=5mm, 350mm distance from the LCD surface to detector lens.



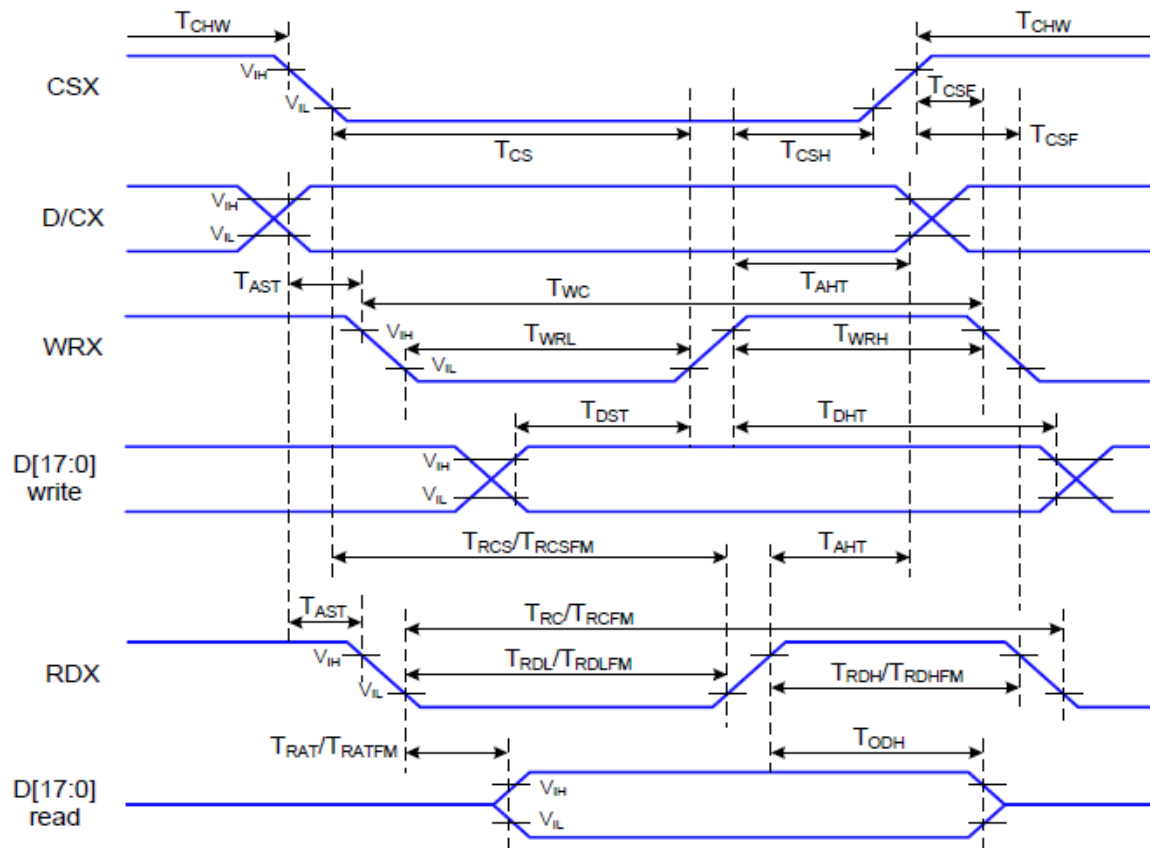
**FIG.3. The definition of viewing angle**



## 7、INTERFACE DESCRIPTION

<i>NO.</i>	<i>Symbol</i>	<i>I/O</i>	<i>DESCRIPTION</i>
1	GND	Power supply	Power ground
2	VCI	Power supply	Power supply to the liquid crystal power supply analog circuit. VCI=2.3~3.3V
3	IOVCC	Power supply	Power supply to the I/O.IOVCC=1.65~3.3V
4	CS	I	Chip select
5	RS	I	Data/Command select
6	WR	I	Write strobe signal
7	RD	I	Read strobe signal
8	RESET	I	LCD RESET signal, Low is active
9~24	D0~D15	I/O	Data bus(D0:LSB; D15:MSB)
25	FMARK (TE)	O	Frame head pulse signal. Utilize this signal when synchronizing RAM data write operations. If not used, please open this pin.
26	YD	I	RTP pin
27	XR	I	RTP pin
28	YU	I	RTP pin
29	XL	I	RTP pin
30	LED-K1	Power supply	Backlight Cathode
31	LED-K2	Power supply	Backlight Cathode
32	LED-K3	Power supply	Backlight Cathode
33	LED-K4	Power supply	Backlight Cathode
34	LED-K5	Power supply	Backlight Cathode
35	LED-K6	Power supply	Backlight Cathode
36	LED-A	Power supply	Backlight Anode
37	GND	Power supply	Power ground

## 8、INPUT TIMING



80-System Bus Interface Timing

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	$T_{AST}$	Address setup time	0		ns	-
	$T_{AHT}$	Address hold time (Write/Read)	10		ns	
CSX	$T_{CHW}$	Chip select "H" pulse width	0		ns	-
	$T_{CS}$	Chip select setup time (Write)	15		ns	
	$T_{RCS}$	Chip select setup time (Read ID)	45		ns	
	$T_{RCSFM}$	Chip select setup time (Read FM)	355		ns	
	$T_{CSF}$	Chip select wait time (Write/Read)	10		ns	
	$T_{CSH}$	Chip select hold time	10		ns	
WRX	$T_{WC}$	Write cycle	66		ns	-
	$T_{WRH}$	Control pulse "H" duration	15		ns	

	T <sub>WRL</sub>	Control pulse "L" duration	15		ns	
RDX (ID)	T <sub>RC</sub>	Read cycle (ID)	160		ns	When read ID data
	T <sub>RDH</sub>	Control pulse "H" duration (ID)	90		ns	
	T <sub>RDL</sub>	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T <sub>RCFM</sub>	Read cycle (FM)	450		ns	When read from frame memory
	T <sub>RDHFM</sub>	Control pulse "H" duration (FM)	90		ns	
	T <sub>RDLFM</sub>	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T <sub>DST</sub>	Data setup time	10		ns	For CL=30pF
	T <sub>DHT</sub>	Data hold time	10		ns	
	T <sub>RAT</sub>	Read access time (ID)	-	40	ns	
	T <sub>RATFM</sub>	Read access time (FM)	-	340	ns	
	T <sub>ODH</sub>	Output disable time	20	80	ns	

## 9、RELIABILITY TEST CONDITIONS

No.	Test Item	Test Condition
1	High Temperature Storage	80°C/120 hours
2	Low Temperature Storage	-30°C/120 hours
3	High Temperature Operating	70°C/120 hours
4	Low Temperature Operating	-20°C/120 hours
5	Temperature Cycle Storage	-20°C(30min.)~25(5min.)~70°C(30min.)×10cycles

### A、Inspection after test:

Inspection after 2~4 hours storage at room temperature, the sample shall be free from defects:

- Air bubble in the LCD;
- Sealleak;
- Non-display;
- Missing segments;
- Glass crack;
- Current is twice higher than initial value.

### B、Remark:

- The test samples should be applied to only one test item.
- Sample size for each test item is 5~10pcs.
- Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

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## **10、INSPECTION CRITERION**

*This specification is made to be used as the standard of acceptance/rejection criteria for TFT-LCD/IPS TFT-LCD module product, and this specification is applicable only in the case that the size of module equal to or exceed than 3.5 inch.*

### **10.1 Sample plan**

*Sampling plan according to GB/T2828.1-2003/ISO 2859-1: 1999 and ANSI/ASQC Z1.4-1993,normal level 2 and based on:*

*Major defect: AQL 0.65*

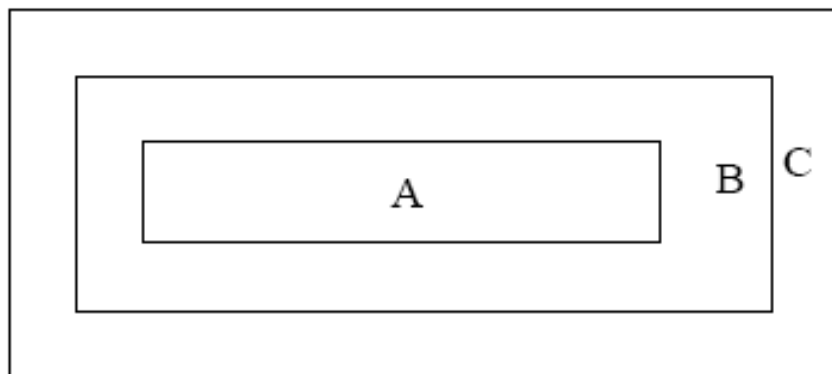
*Minor defect: AQL 1.5*

### **10.2 Inspection condition**

*Viewing distance for cosmetic inspection is about 30cm with bare eyes, and under an environment of 20~40W light intensity, all directions for inspecting the sample should be within 45 °against perpendicular line. (Normal temperature 20~25 °C and normal humidity 60 ±15%RH )*

### **10.3 Definition of Inspection Item.**

**A、 Definition of inspection zone in LCD.**



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*Zone A: character/Digit area*

*Zone B: viewing area except Zone A (Zone A + Zone B=minimum Viewing area)*

*Zone C: Outside viewing area (invisible area after assembly in customer's product)*

*Fig.1 Inspection zones in an LCD*

*Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.*

***B、 Definition of some visual defect***

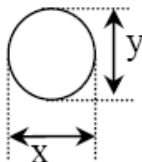
<i>Bright dot</i>	<i>Because of losing all or part function, bad pixel dots appear bright and the size is more than 50% of one dot in which LCD panel is displaying under black pattern.</i>
<i>Dark dot</i>	<i>Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture, or pure whiter picture.</i>

***10.4 Major Defect***

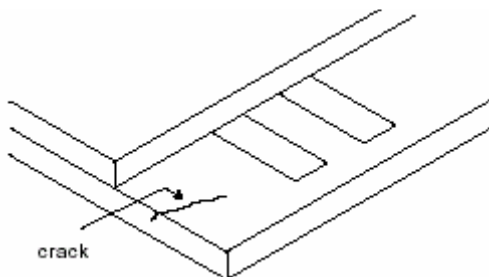
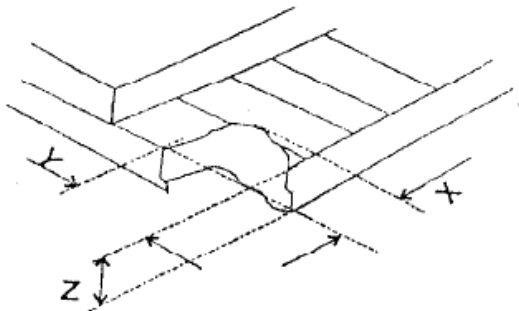
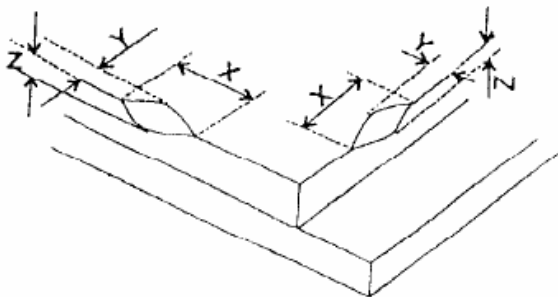
<b><i>Item No.</i></b>	<b><i>Items to be inspected</i></b>	<b><i>Inspection standard</i></b>	<b><i>Classification of defects</i></b>
<i>1</i>	<i>Functional defects</i>	<i>1) No display 2) Display abnormally 3) Missing vertical, horizontal segment 4) Short circuit 5) Excess power consumption 6)Backlight no lighting, flickering and abnormal lighting</i>	<i>major</i>
<i>2</i>	<i>Missing</i>	<i>Missing component</i>	
<i>3</i>	<i>Outline dimension</i>	<i>Overall outline dimension beyond the drawing is not allowed</i>	



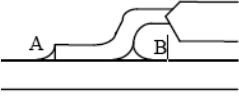
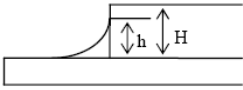
## 10.5 Minor Defect

Item No.	Items to be inspected	Inspection standard					Classification of defects	
1	Bright dot /dark dot defect	<div>Zone</div>		Acceptable Qty			Minor	
				A+B				
				3.5 ~7"	7 ~10.1"	>10.1"		
		Bright pixel dot		1	2	3		Acceptable
		Dark pixel dot		4	4	4		
		2bright dots adjacent		0	0	0		
		2dark dots adjacent		0	0	0		
		Total bright and dark dots		5	6	7		
Note: Minimum distance between defective dots is more than 5mm; Pixel dots' function is normal, but bright dots caused by foreign material and other reasons are judged by the dot defect of 5.2.								
2	<div>Dot defect</div> <div></div> <div><math>\Phi =(x+y) /2</math></div>	<div>Zone</div>		Acceptable Qty			Minor	
				A+B				
				3.5'' ~7''	7 ~10.1''	>10.1''		
		$\Phi \leqslant 0.2$		Acceptable	Acceptable	Acceptable		Acceptable
		$0.2 < \Phi \leqslant 0.5$		4	5	6		
		$\Phi > 0.5$		0	0	0		
		Note: 1. Minimum distance between defective dots is more than 5 mm; 2. The quantity of defect is zero in operating condition.						
		3	Linear defect	<div>Zone</div>		Acceptable Qty		
A+B								
Size (mm)	3.5'' ~7''					7 ~10.1''	>10.1''	
Length	Width			3.5'' ~7''	7 ~10.1''	>10.1''	C	
Ignore	$W \leqslant 0.05$			Acceptable	Acceptable	Acceptable	Acceptable	
$L \leqslant 5.0$	$0.05 < W \leqslant 0.1$			4	5	6		
$L > 5.0$	$W > 0.1$			0	0	0		

4	Polarizer defect	5.4.1 Polarizer Position ( i ) Shifting in position should not exceed the glass outline dimension. ( ii ) Incomplete covering of the viewing area due to shifting is not allowed.	Minor																															
		5.4.2 Dirt on polarizer Dirt which can be wiped easily should be acceptable.																																
		5.4.3 Polarizer Dent & Air bubble																																
		<table><tr><th colspan="2" rowspan="2">Zone Size(mm)</th><th colspan="3">Acceptable Qty</th><th rowspan="2">C</th></tr><tr><th colspan="3">A+B</th></tr><tr><th colspan="2"></th><th>3.5''~7''</th><th>7~10.1''</th><th>&gt;10.1''</th><th></th></tr><tr><td colspan="2"><math>\Phi \leq 0.2</math></td><td>Acceptable</td><td>Acceptable</td><td>Acceptable</td><td rowspan="3">Acceptable</td></tr><tr><td colspan="2"><math>0.2 &lt; \Phi \leq 0.5</math></td><td>4</td><td>5</td><td>6</td></tr><tr><td colspan="2"><math>\Phi &gt; 0.5</math></td><td>0</td><td>0</td><td>0</td></tr></table>		Zone Size(mm)		Acceptable Qty			C	A+B					3.5''~7''	7~10.1''	>10.1''		$\Phi \leq 0.2$		Acceptable	Acceptable	Acceptable	Acceptable	$0.2 < \Phi \leq 0.5$		4	5	6	$\Phi > 0.5$		0	0	0
		Zone Size(mm)				Acceptable Qty				C																								
				A+B																														
				3.5''~7''	7~10.1''	>10.1''																												
		$\Phi \leq 0.2$		Acceptable	Acceptable	Acceptable	Acceptable																											
		$0.2 < \Phi \leq 0.5$		4	5	6																												
		$\Phi > 0.5$		0	0	0																												
5.4.4 Polarizer scratch (i) If the polarizer scratch can be seen after cover assembling or in the operating condition, judge by the linear defect of 5.3. ( ii )If the polarizer scratch can be seen only in non-operating condition or some special angle, judge by the following:																																		
<table><tr><th colspan="2" rowspan="2">Zone Size (mm)</th><th colspan="3">Acceptable Qty</th><th rowspan="2">C</th></tr><tr><th colspan="3">A+B</th></tr><tr><th>Length</th><th>Width</th><th>3.5''~7''</th><th>7~10.1''</th><th>&gt;10.1''</th><th></th></tr><tr><td>Ignore</td><td><math>W \leq 0.05</math></td><td>Acceptable</td><td>Acceptable</td><td>Acceptable</td><td rowspan="3">Acceptable</td></tr><tr><td><math>1.0 &lt; L \leq 5.0</math></td><td><math>0.05 &lt; W \leq 0.20</math></td><td>4</td><td>5</td><td>6</td></tr><tr><td><math>L &gt; 5.0</math></td><td><math>W &gt; 0.2</math></td><td>0</td><td>0</td><td>0</td></tr></table>	Zone Size (mm)		Acceptable Qty			C	A+B			Length	Width	3.5''~7''	7~10.1''	>10.1''		Ignore	$W \leq 0.05$	Acceptable	Acceptable	Acceptable	Acceptable	$1.0 < L \leq 5.0$	$0.05 < W \leq 0.20$	4	5	6	$L > 5.0$	$W > 0.2$	0	0	0			
Zone Size (mm)			Acceptable Qty				C																											
		A+B																																
Length	Width	3.5''~7''	7~10.1''	>10.1''																														
Ignore	$W \leq 0.05$	Acceptable	Acceptable	Acceptable	Acceptable																													
$1.0 < L \leq 5.0$	$0.05 < W \leq 0.20$	4	5	6																														
$L > 5.0$	$W > 0.2$	0	0	0																														
5	MURA	Using 3% ND filter, it's NG if it can be seen in R,G,B picture.	Minor																															
	White/Black dot (MURA )	Visible under: ND3%; $D \leq 0.15mm$ , Acceptable; $0.15mm < D \leq 0.5mm$ , $N \leq 4$ ; $D > 0.5mm$ , Not allowable.																																

6	Glass defect	<div>(i) Crack Cracks are not allowed.</div> <div></div>	Minor								
		<div>(ii) TFT chips on corner</div> <div></div> <div><table><tr><th>X</th><th>Y</th><th>Z</th><th>Acceptable</th></tr><tr><td>≤3.0</td><td>≤3.0</td><td>Not more than the thickness of glass</td><td>N ≤3</td></tr></table><div>Chips on the corner of terminal shall not be allowed to extend into the ITO pad or expose perimeter seal.</div></div>	X	Y	Z	Acceptable	≤3.0	≤3.0	Not more than the thickness of glass	N ≤3	Minor
		X	Y	Z	Acceptable						
≤3.0	≤3.0	Not more than the thickness of glass	N ≤3								
<div>(iii) Usual surface crack</div> <div></div> <div><table><tr><th>X</th><th>Y</th><th>Z</th><th>Acceptable</th></tr><tr><td>≤1.5</td><td>≤1.5</td><td>Not more than the thickness of glass</td><td>N ≤4</td></tr></table><div>It is only applicable to the upper glass of LCD.</div></div>	X	Y	Z	Acceptable	≤1.5	≤1.5	Not more than the thickness of glass	N ≤4	Minor		
X	Y	Z	Acceptable								
≤1.5	≤1.5	Not more than the thickness of glass	N ≤4								

## 10.6 Module Cosmetic Criteria

Item No.	Items to be inspected	Inspection Standard	Classification of defects
1	Difference in Spec.	Not allowable	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing	Major
		No soldering bridge	Major
		No cold soldering	Minor
4	Resist flaw on PCB	Visible copper foil ( $\Phi 0.5$ mm or more) on substrate pattern is not allowed	Minor
5	FPC gold finger	No dirt, breaking, oxidation lead to black	Major
6	Backlight plastic frame	No deformation, crack, breaking, backlight positioning column breaking, obvious nick.	Minor
7	Marking printing effect	No dark marking, incomplete, deformation lead to unable to judge	Minor
8	Accretion of metallic Foreign matter	No accretion of metallic foreign matter (Not exceed $\Phi 0.2$ mm)	Minor
9	Stain	No stain to spoil cosmetic badly	Minor
10	Plate discoloring	No plate fading, rusting and discoloring	Minor
11	1. Lead parts	a. Soldering side of PCB Solder to form a 'Filet' all around the lead. Solder should not hide the lead form perfectly.	Minor
		b. Components side(In case of 'Through Hole PCB') Solder to reach the Components side of PCB.	Minor
	2. Flat packages	Either 'Toe'(A) or 'Seal'(B) of the lead to be covered by "Filet". Lead form to be assume over Solder. 	Minor
	3. Chips	$(3/2) H \geq h \geq (1/2) H$ 	Minor
	4. Solder ball/Solder splash	a. The spacing between solder ball and the conductor or solder pad $h \geq 0.13$ mm. The diameter of solder ball $d \leq 0.15$ mm.	Minor
		b. The quantity of solder balls or solder splashes isn't beyond 5 in 600 mm <sup>2</sup> .	Minor
		c. Solder balls/Solder splashes do not violate minimum electrical clearance.	Major