TFT LCD MODULE

2.0inch 176RGB*220DOTS

MODULE NUMBER: PV02000PD24B

REVISION: V01

Customer Approval:

■ **Approved For Specifications**

☐ Approved For Specifications & Sample

Prepared by	Checked by	Approved by
Booby		

Document Revision History

Version	Date	Page	Description	Changed By
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1. LCM Specification

1.1 Description

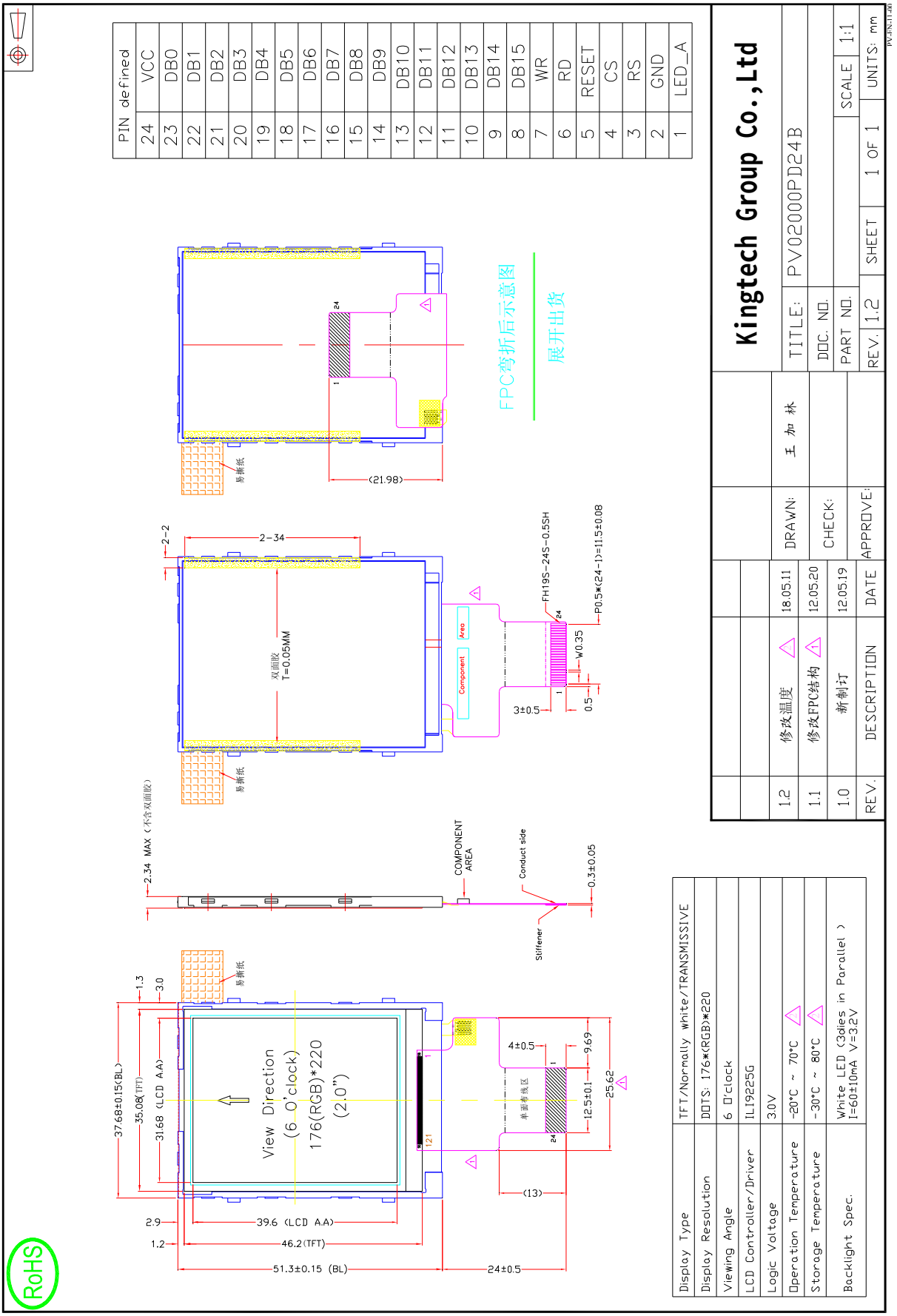
PV02000PD24B is a transmissive type color active matrix liquid crystal display(LCD) which uses amorphous thin film transistor(TFT) as switching devices. This product is composed of a TFT LCD panel, a drive IC, a FPC and a LED-backlight unit. The active display area is 2.0 inches diagonally measured and the native resolution is 176*RGB*220.Features of this product are listed in the following table.

1.2 Functions & Features

Table 1.1 Module Functions & Features

Parameter	Value	Unit
LCD Mode	TFT/Transmissive	-
Color Depth	262K	-
Display Resolution	176RGB*220	pixels
Module Size	51.30(H)*37.68(W)*2.40(T)(Exclude FPC)	mm
Active Area (A.A)	39.60(H)*31.68(W)	mm
Pixel Arrangement	RGB-stripe	-
Viewing Direction	6 o' clock	
Display Mode	Normally white	
LCD Controller/Driver	ILI9225G	-
IC Package Type	COG	-
MPU Interface	**Standard 8080 system 8 / 16 bit parallel interface (**default : 16-bit)	-
Power Supply Voltage	2.8~3.3	V
Back-light	White LED*3	PCS

2. Mechanical Specification



3. Pin Descriptions

Pin No.	Symbol	I/O	Functional	Remark
1	LED-A	P	LED Power supply +	
2	GND	P	System ground.	
3	/RS	I	Register select signal (80-system). Low: Index register or internal status is selected. High: Control register is selected.	
4	/CS	I	80-system: Chip select pin.	
5	RESET	I	Reset signal pin.	
6	/RD	I	80-system : /RD (read strobe signal)	
7	WR	I	White	
8~23	DB15~DB0	I/O	Data bus (When IM0=1, use DB0~DB7) .	
24	IOVCC	P	Digital power supply, 2.3~3.3V	

4. Electrical Units

4.1 Absolute Maximum Ratings

The absolute maximum ratings are list on Table 4.1. When used out of the absolute maximum ratings, the LCM may be permanently damaged. Using the LCM within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the LCM will malfunction and cause poor reliability.

Table 4.1 Module Absolute Maximum Ratings

Item	Symbol	Unit	Value	Note
Power Supply Voltage (1)	Vdd	V	-0.3 to +4.5	
Power Supply Voltage (2)	VGH ~ VSS	V	-0.3 to +18.5	
Power Supply Voltage (3)	VSS ~ VGL	V	0 to -16.5	
Operating Temperature	Top	°C	-20 to +70	
Storage Temperature	Tst	°C	-30 to +80	
Operating Humidity	Hop	%(RH)	10~90	

(VSS=0V)

4.2 Electrical characteristics (Ta=25°C)

Table 4.2:DC Characteristic (Vcc = 2.5 ~ 3.3V)

Item		Symbol	Condition	Min.	Type.	Max.	Unit
Supply Voltage	Logic	Vdd	---	2.8	3.0	3.3	V
Input Voltage	H level	V_{IH}	---	0.8V_{dd}	---	V_{dd}	V
	L level	V_{IL}		0	---	0.2V_{CC}	
Current Consumption		I_{DD}	With internal voltage generation; VDD=3.0V;Tamb=25℃;	---	---	---	mA

4.3 Back-light Specification

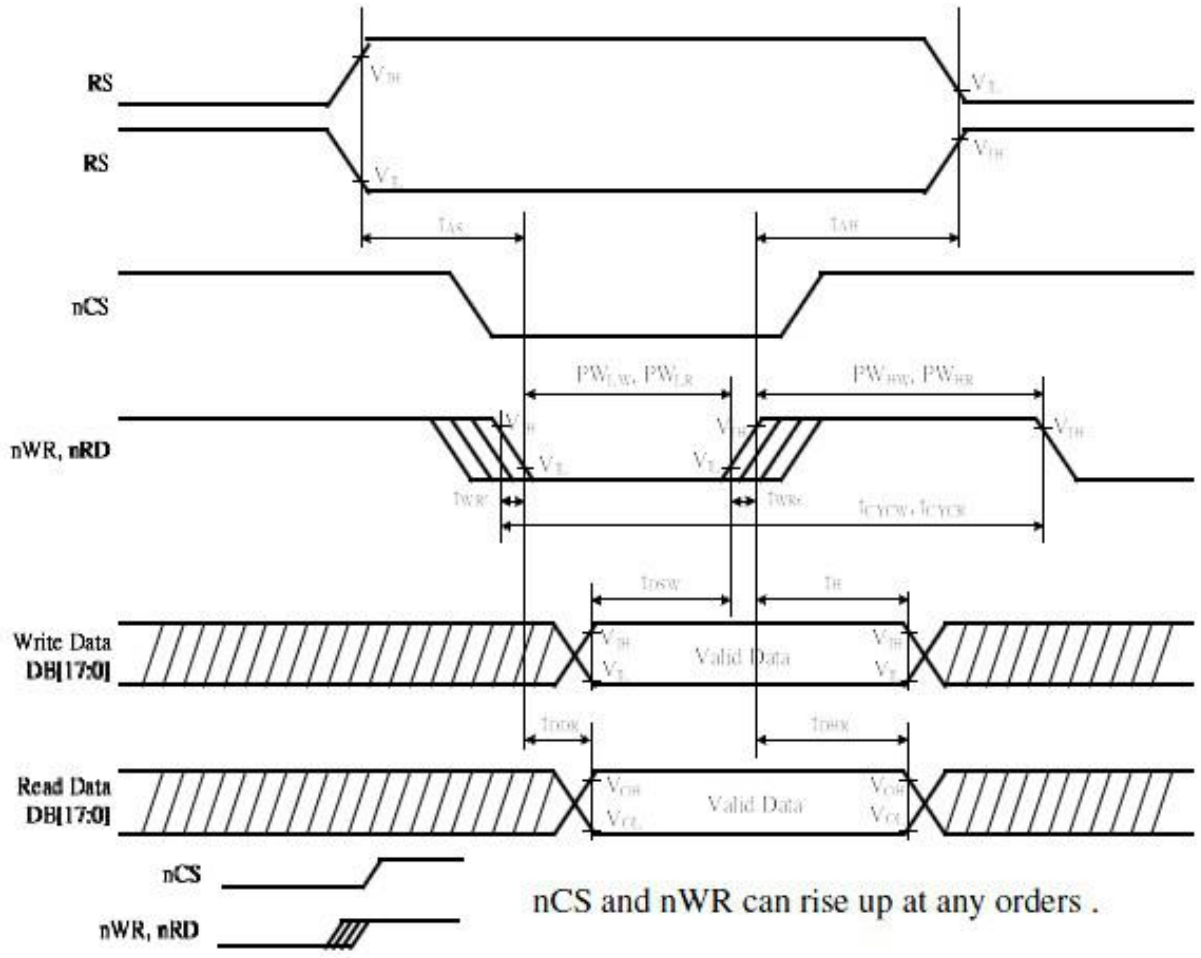
Table 4.3 Back-light Characteristics

Item	Symbol	Conditions	Min.	Type.	Max.	Unit
Supply Voltage	VF	Only Backlight	-	3.2	-	V
Supply Current	IF		60			mA
Average Brightness	IV	Backlight Current IF=80mA	3200	-	-	Cd/m2
CIE Color Coordinate (Without LCD)	X	Backlight Current IF=60mA	0.26	-	0.3	–
	Y		0.26	-	0.3	
Uniformity	B	Backlight Current IF=60mA	80	–	–	%
Color	White					

Note: 3 LEDs in parallel connection.

5. AC Characteristics

5.1 80-system bus interface operation



Item		Symbol	Unit	Min.	Max.	Test Condition
Bus cycle time	Write	t_{CYCW}	ns	66	-	-
	Read	t_{CYCR}	ns	300	-	-
Write low-level pulse width		PW_{LW}	ns	35	500	-
Write high-level pulse width		PW_{HW}	ns	35	-	-
Read low-level pulse width		PW_{LR}	ns	150	-	-
Read high-level pulse width		PW_{HR}	ns	150	-	
Write / Read rise / fall time		t_{WRr}/t_{WRf}	ns	-	15	
Setup time	Write (RS to nCS, E/nWR)	t_{AS}	ns	10	-	
	Read (RS to nCS, RW/nRD)			5	-	
Address hold time		t_{AH}	ns	5	-	
Write data set up time		t_{DSW}	ns	10	-	
Write data hold time		t_H	ns	15	-	
Read data delay time		t_{DDR}	ns	-	100	
Read data hold time		t_{DHR}	ns	5	-	

6. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25℃. The values specified are at an approximate distance 50cm from the TFT-LCD surface at a viewing angle of Φ and θ equal to 0°.

Measurement condition: Refer to next pages (C-light source, Halogen Lamp)

*1): with Polarizer *2): without Polarizer *3): Only Color Filter glass

Item		Symbol	Conditions	Specifications			Unit
				Min.	Typ.	Max.	
Transmittance		T%	Viewing normal angle $\theta_X = \theta_Y = 0°$	-	5.5	-	%
Contrast Ratio		CR		-	300	-	
Response Time (by Quick)		T_{on}		-	10	-	ms
		T_{off}		-	20	-	ms
Viewing Angle	Hor.	θ_{X+}	Center CR>10	-	45	-	deg.
		θ_{X-}		-	45	-	
	Ver.	θ_{Y+}		-	45	-	
		θ_{Y-}		-	20	-	
CF only Color Chromaticity (CIE 1931)	Red	X_R	Viewing normal angle $\theta_X = \theta_Y = 0°$	(0.587)	(0.617)	(0.647)	
		Y_R		(0.300)	(0.330)	(0.360)	
	Green	X_G		(0.252)	(0.282)	(0.312)	
		Y_G		(0.521)	(0.551)	(0.561)	
	Blue	X_B		(0.131)	(0.161)	(0.191)	
		Y_B		(0.081)	(0.111)	(0.141)	
	White	X_W		(0.276)	(0.306)	(0.336)	
		Y_W		(0.292)	(0.322)	(0.352)	

Notes : 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the center point across the TFT-LCD surface 500mm from the surface with all pixels displaying white. For more information see FIG 1.

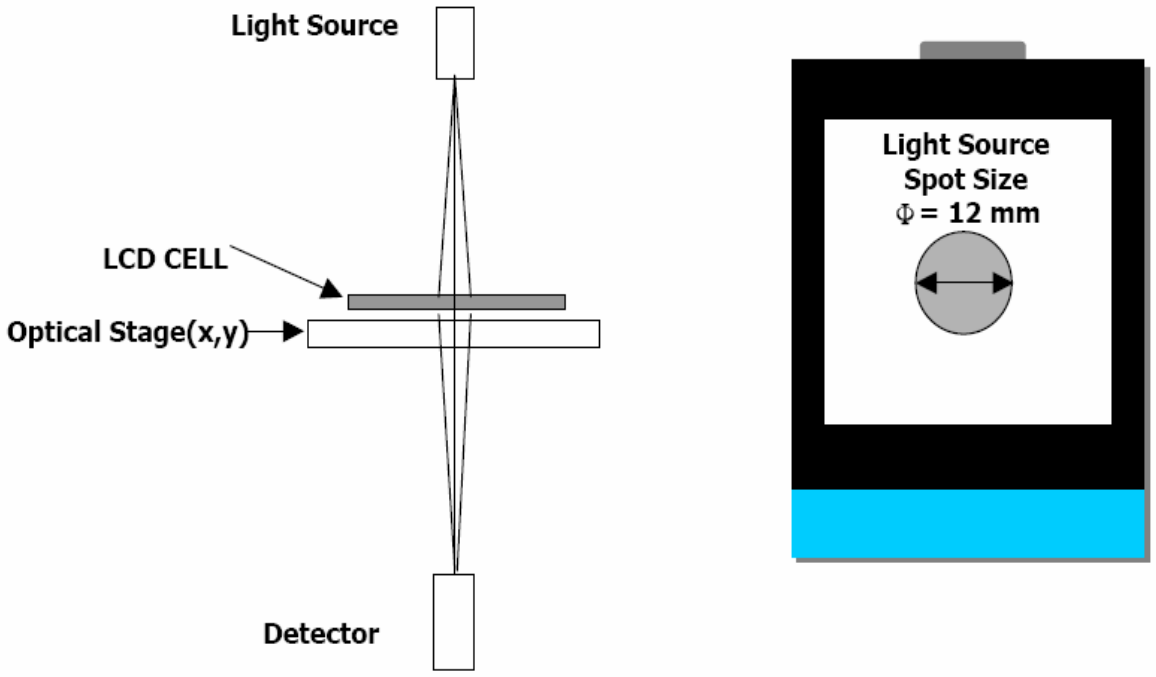
3. Response time is the time required for the display to transition from white to black(Rise Time, Tr) and from black to white(Falling Time, Tf). For additional information see FIG 3.

4. Viewing angle is the angle at which 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 TFT-LCD surface. For more information see FIG 4.

5. Optimum contrast is obtained by adjusting the TFT-LCD Threshold voltage(Vth & Vsat)

FIG. 1 Optical Characteristic Measurement Equipment and Method

LCD-7000 System



<Transmissive Mode>

FIG. 2 The definition of Vth and Vsat

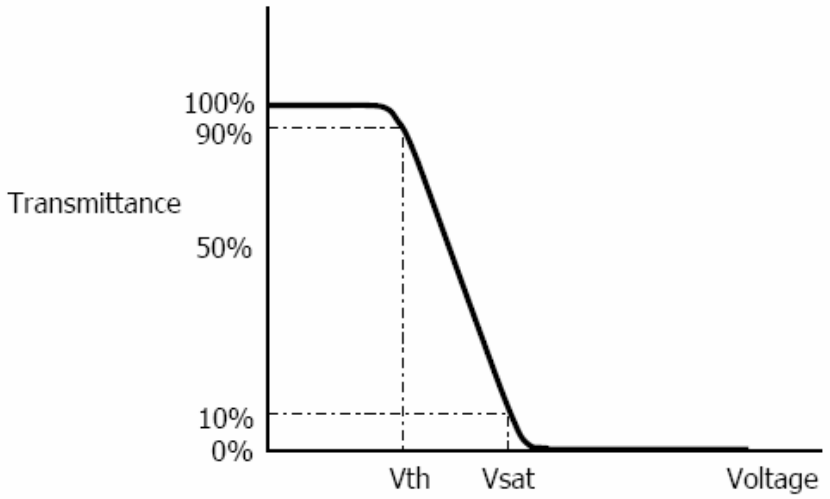
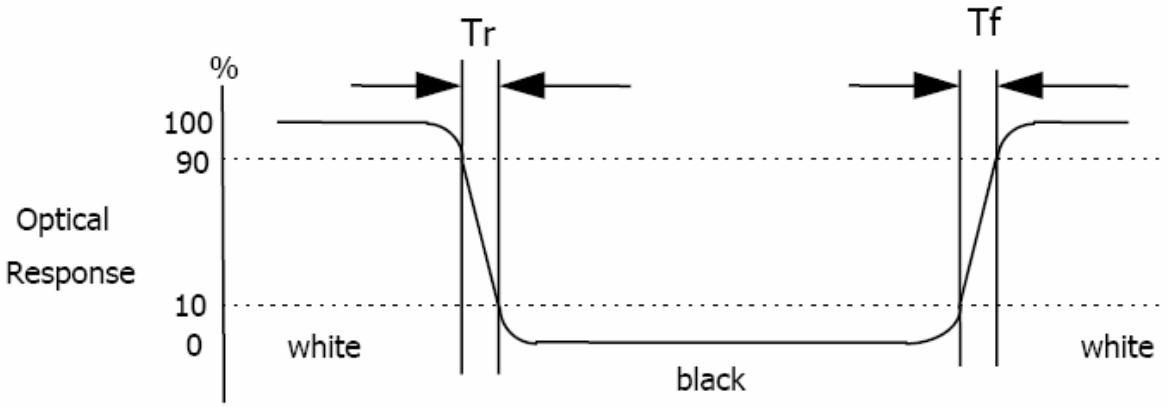


FIG. 3 The definition of Response Time

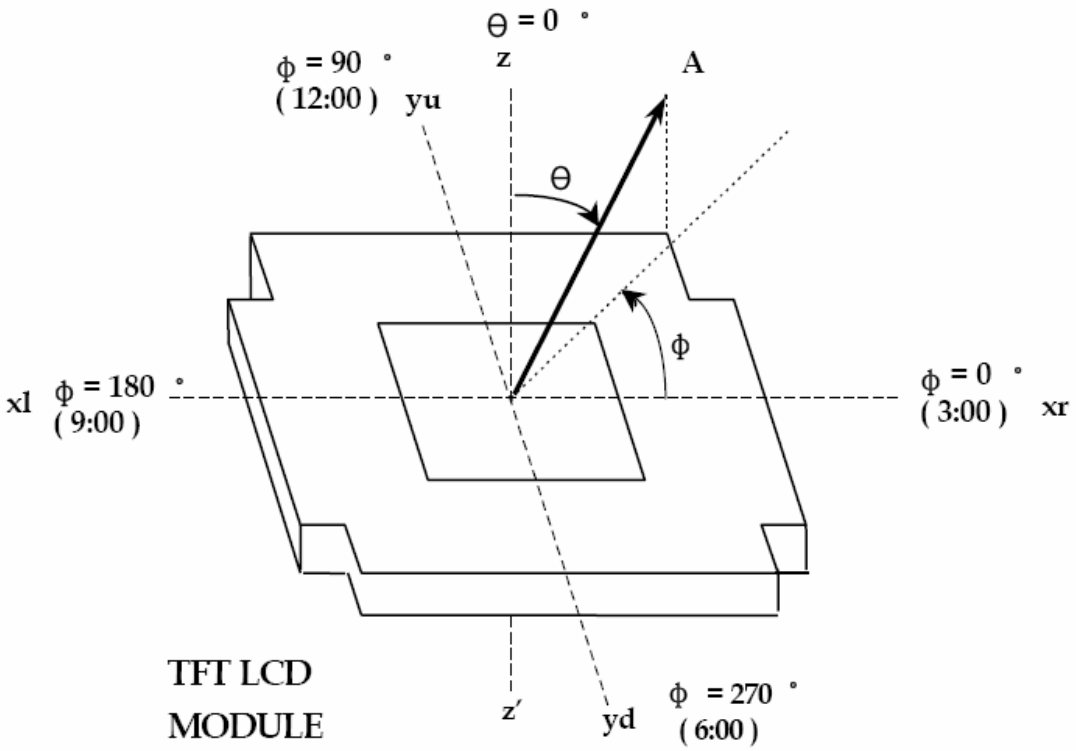
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



* Voltage conditions for Response time
  Vgate : 19V DC
  Vdata : 0V~3.3V DC
  Vcom : 0V (Ground)

FIG. 4 The definition of viewing angle

<dimension of viewing angle range>



7. Reliability Test Items

No.	Test Item	Test Condition	Check Time
1	High temp storage	T=80℃	72Hrs
2	Low temp storage	T=-30℃	72Hrs
3	High temp operation	T=70℃	72Hrs
4	Low temp operation	T=-20℃	72Hrs
5	High temp & high humidity	T=50℃ H=90%	72Hrs

Note1: Pass: Normal display image with no obvious non-uniformity and no line defect. Fail: No display image, obvious non-uniformity, or line defects. Partial transformation of the module parts should be ignored.

Note2: Evaluation should be tested after storage at room temperature for two hours.

Note3: Evaluation should be tested with storage temperature.

8. Package(TBD)

9.Handling Precautions

9.1 Safety

The liquid crystal in the LCD is poisonous. Keep away from your mouth and eyes. If the liquid crystal contacts with your skin, mouse or clothes, use soap to wash it off immediately.

9.2 Handling

i.The LCD panel is made of very thin glass. Mechanical impact or extrusion to the surfaces hould be prevented.

ii. The polarizer attached on the display is very easy to be damaged, handle it with special attention.

iii. To avoid contamination on the display surface, do not touch the display surface with bare hands.

iv. The transparent electrodes may be disconnected if you use the LCD panel under dew-condensing environment.

v. The characteristics of the semiconductor devices may be affected when they are exposed to light, possibly resulting in malfunctioning of the ICs. To prevent such malfunctioning of the ICs, make sure the application and the mounting of the panel are designed so that the IC is not exposed to light.

9.3 Static Electricity

Ground soldering iron tips, tools and testers when you operate. Also ground your body when handling the products and store the products in an anti-electrostatic container.

9.4 Storage

Store the products in a dark place where the temperature is within the range of 25±10℃ and with low humidity (65%RH or less). Do not store the LCD product in an atmosphere containing organic solvents or corrosive gases.

9.5 Cleaning

Do not wipe the polarizer with dry cloth, as it might cause scratching. Wipe the polarizer with a soft cloth soaked with petroleum IPA. Other chemical might damage the panel.

10. QC

10.1 Purpose

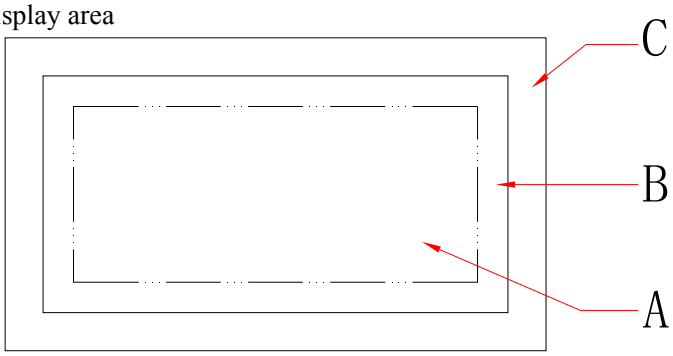
To ensure the stability of our product and standardize our inspection

10.2 Application Range

This standard is applied to all 3.5 inch and smaller sized LCM product from Elsun Technology Co.Ltd

10.3 Definition of inspection area

C area: The area covered after installation
B area: visible area
A area: display area

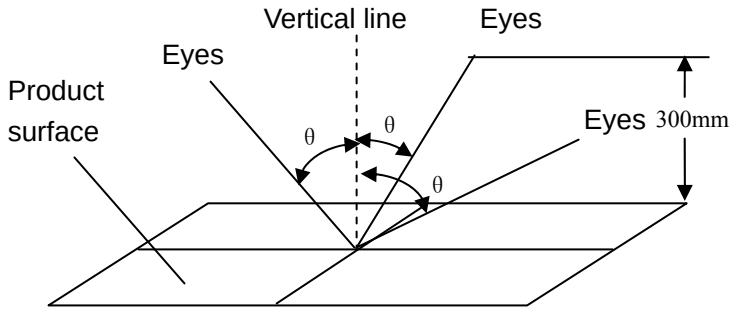


10.4 The environmental condition of inspection

Lighting conditions should be 20 ~ 40W fluorescent lamp (illumination at 1000 ± 200 lux)

Test ambient temperature should be 23 ± 5 ℃, humidity at 50 ± 20% RH

The tested products should be placed 300mm away from the examiner's eye, and 30 degrees in the vertical direction observed within the region



10.5 Identification

10.5.1 Bright dot: dots appearing bright and unchanged in size when the LCD panel is under black pattern.

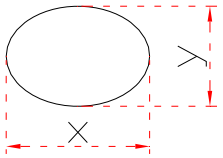
10.5.2 Dark dot: dots appearing dark and unchanged size when the LCD panel is under RGB picture.

10.6 Inspection items and criteria

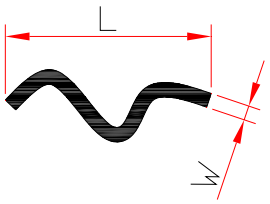
10.6.1 Serious defect

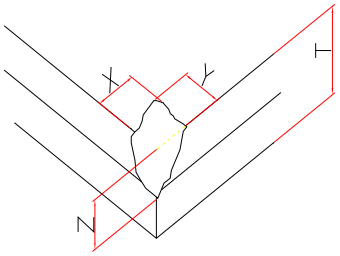
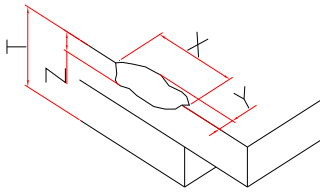
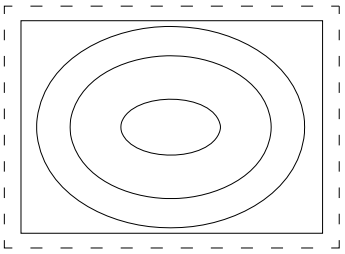
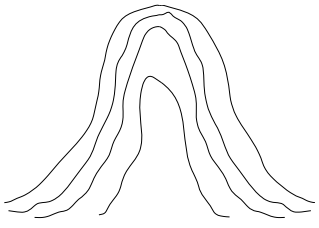
No	inspection item	inspection criteria	defect grade
10.6.1.1	function failure	1) Non-display not allowed 2) Line missing not allowed 3) Invalid touch and drift not allowed (if need)	main defect
10.6.1.2	break	broken display not allowed	main defect
10.6.1.3	dimension	Dimension tolerance out of specified in the drawing not allowed.	main defect

10.6.2 Appearance defect

<table>
<tr><th>No</th><th>Inspection item</th><th>inspection criteria</th><th>defect grade</th></tr>
<tr><td rowspan="2">10.6.2.1</td><td rowspan="2">Dot defect
black dot, white dot, dirt on surface, stain, bubble</td><td>1. dot defect identification:
$\Phi = \frac{(\chi + \gamma)}{2}$  </td><td rowspan="2">Minor defect</td></tr>
<tr><td>2. inspection criteria range
<table>
<tr><th rowspan="2">Area and quantity dimension(mm)</th><th colspan="3">quantity allowed</th></tr>
<tr><th>A area</th><th>B area</th><th>C area</th></tr>
<tr><td>Φ ≤0.15</td><td colspan="2">ignore</td><td rowspan="4">ignore</td></tr>
<tr><td>0.15＜ Φ ≤0.2</td><td colspan="2">2 （spacing>=5mm ）</td></tr>
<tr><td>0.2＜ Φ ≤0.27</td><td colspan="2">1</td></tr>
<tr><td>Φ ＞0. 27</td><td colspan="2">0</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No</th><th>Inspection item</th><th>inspection criteria</th><th>defect grade</th></tr>
<tr><td rowspan="2">10.6.2.2</td><td rowspan="2">line defect
visible
black/white line</td><td>1. identification of line dimension

L: length
W: width
  </td><td rowspan="2">Minor defect</td></tr>
<tr><td>2. inspection criteria
<table>
<tr><th colspan="2">dimension(mm)</th><th colspan="3">quantity allowed（total 3 pcs ）</th></tr>
<tr><th rowspan="2">L (length)</th><th rowspan="2">W (width)</th><th colspan="3">area</th></tr>
<tr><th>A area</th><th>B area</th><th>C area</th></tr>
<tr><td>ignore</td><td>W≤0.03</td><td colspan="2">ignore</td><td rowspan="4">ignore</td></tr>
<tr><td>L≤3. 0</td><td>0.03＜W≤ 0. 05</td><td colspan="2">2</td></tr>
<tr><td>L≤2. 0</td><td>0.05＜W≤ 0. 07</td><td colspan="2">1</td></tr>
<tr><td></td><td>W＞0. 07</td><td colspan="2">count according to dot defect</td></tr>
</table></td></tr>
<tr><td>10.6.2.3</td><td>scratch</td><td>1-If the scratch is visible after installation or at work, refer to 10.6.2.2
2-If the scratch is visible at special angel or at non-working status, refer to the following standards
<table>
<tr><th colspan="2">dimension（mm）</th><th colspan="3">Quantity allowed</th></tr>
<tr><th rowspan="2">L（length）</th><th rowspan="2">W（width）</th><th colspan="3">area</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>ignore</td><td>W≤0.03</td><td colspan="2">ignore</td><td rowspan="4">ignore</td></tr>
<tr><td>5.0＜L≤10. 0</td><td>0.03＜W≤ 0. 05</td><td colspan="2">2</td></tr>
<tr><td>L≤5. 0</td><td>0.05＜W≤ 0. 07</td><td colspan="2">1</td></tr>
<tr><td></td><td>W＞0. 07</td><td colspan="2">Not allowed</td></tr>
</table></td><td>Minor defect</td></tr>
</table>

No	Inspection item	inspection criteria	defect grade
10.6.2.4	Glass defect	1. broken angle X≤1.5mm Y≤2.0mm or X≤2.0mm Y≤1.5mm Meanwhile Z<T ignore  2. other broken part X≤5.0mm Y≤0.8mm Meanwhile Z≤T ignore 	Minor defect
10.6.2.5	Newton ring	1.regular Newton ring  ① Newton ring area>1/3 T/P area; not acceptable. ② Newton ring area≤1/3 T/P area and doesn't affect the display result and no line distortion; acceptable 2. Non-regular Newton ring  ① Newton ring area>1/2 T/P area, or no matter how big as long as it affects the display result; not acceptable Newton ring area≤1/2 T/P area, and doesn't affect the display result and witouth line distortion; acceptable	Minor defect

NO	Inspection item	inspection criteria	defect grade
10.6.2.6	FPC	1. copper foil off, warping, crack and oxidation are not allowed 2. FPC crack, break, serious scratch and crease are not allowed	main defect
		3. if no special requirements, no release paper on double-sided adhesive FPC is not allowed. 4. Slight creases and scratches not exposed from the copper foil and with no affect to appearance and function are allowed. 5. if no special requirements, no insulating tape at welding part on backlight and touch-screen is not allowed.. 6. Parts off, breakage and deform are not allowed. 7. print on the surface should be clear and correct.	Minor defect
10.6.2.7	basic appearance requirements	1.- clean appearance, no dirt, fingerprints and other traces. 2. ITO circuit on COG coating area should not be exposed. 3. Rust, sever scratch, deformation, obvious burrs and color dirt are not allowed. 4. Mis-assembly, part missing are not allowed. 5. Bubble caused by mis-pasted polaroid refers to 10.6.2.1 6. For watermark, the criteria is upon agreed by both parties.	Minor defect

10.6.3 electric defect

No	Inspection item	inspection criteria	defect grade
10.6.3.1	picture defect	Non-display, more or less image and display defect are not allowed.	main defect
10.6.3.2	bright/dark line	Not allowed.	main defect
10.6.3.3	display dot defect	1. one dot is acceptable. 2. Under bright status, 2 dark dots with more than 5mm distance is allowed. 3. Totally 2 bright or dark dots are acceptable. 4. The other defect under bright status refers to 10.6.2.1 Note: Electric bright/dark dot means one pixel; less than 1/2 of 1 pixel can be ignored.	Minor defect
10.6.3.4	connected dot/line defect	1. Two continuous defect pixel connected dots are not allowed. 2. Line defect refers to 10.6.2.2	Minor defect
10.6.3.5	wrong view direction	Wrong view directions, such as opposite view angle, are not allowed.	main defect
10.6.3.6	back light defect	1. Backlight off are not allowed. 2. Uneven light, dead light, flicker light, dark angle, light leakage are not allowed. 3. Brightness should comply with drawing	main defect