



承认 编码: CR \_\_\_\_\_

**TFT LCD MODULE**  
**1.54 inch 240RGB\*240DOTS**

**MODULE NUMBER: PV15401KLD24D**

**REVISION: V00**

Customer Approval:

- Approved For Specifications
- Approved For Specifications & Sample**

Prepared by	Checked by	Approved by
David		



## Document Revision History

<b>Version</b>	<b>Date</b>	<b>Page</b>	<b>Description</b>	<b>Changed By</b>
V00	2017-02-28	-	First issue	David



## Index

Contents	Page
1. LCM Specification .....	4
2. Mechanical Specification...	5
3. Pin Descriptions .....	6
4. Electrical Units.....	7
5. AC Characteristics .....	9
6. Power On/Off Sequence...	10
7. Optical Specifications...	11
8. Reliability Test Items...	14
9. Handling Precautions...	14
10. QC...	16



## 1. LCM Specification

### 1.1 Description

**PV15401KLD24D** 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 1.54 inches diagonally measured and the native resolution is 240\*RGB\*240.Features of this product are listed in the following table.

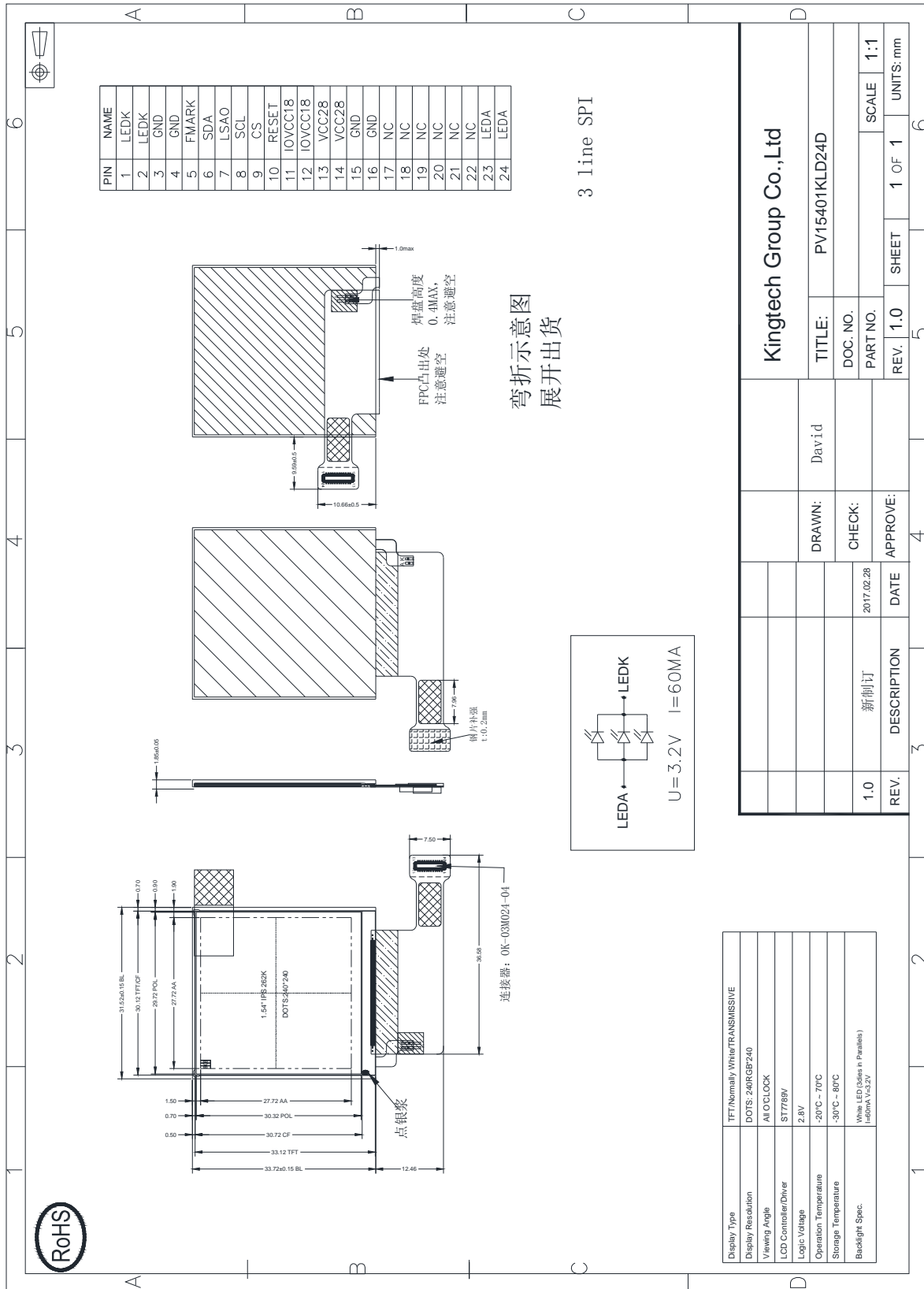
### 1.2 Functions & Features

**Table 1.1 Module Functions & Features**

<b>Parameter</b>	<b>Value</b>	<b>Unit</b>
LCD Mode	TFT/Transmissive	-
Color Depth	262K	-
Display Resolution	240RGB*240	pixels
Module Size	31.52(H)*33.72(W)*1.85(T)(Exclude FPC)	mm
Active Area (A.A)	27.72(H)*27.72(W)	mm
Pixel Arrangement	RGB-stripe	-
Viewing Direction	All O' clock	
Display Mode	Normally Black	
LCD Controller/Driver	ST7789V	-
IC Package Type	COG	-
Interface	<b>3-Line SPI</b>	-
Power Supply Voltage	2.8	V
LCM Brightness	300	cd /m <sup>2</sup>
Back-light	White LED*3	PCS



## 2. Mechanical Specification





### 3. Pin Descriptions

Pin No.	Symbol	I/O	Functional	Remark
1	LED_K	P	Backlight negative	
2	LED_K	P	Backlight negative	
3	GND	P	Ground	
4	GND	P	Ground	
5	FMARK	I	Tearing effect signal is used to synchronize MCU to frame memory	
6	SDA	I/O	The data is applied on the rising edge of the SCL signal.	
7	LSA0	I	Second Data lane in 2 data lane serial interface	
8	SCL	I	This pin is used as the serial interface clock in SPI	
9	CS	I	Chip select input pin	
10	RESET	I	Reset pin. Setting either pin low initializes the LSI.	
11	IOVCC18	P	Low voltage power supply for interface logic circuits (1.65 ~ 3.3 V)	
12	IOVCC18	P	Low voltage power supply for interface logic circuits (1.65 ~ 3.3 V)	
13	VCC28	P	High voltage power supply for analog circuit blocks (2.5 ~ 3.3 V)	
14	VCC28	P	High voltage power supply for analog circuit blocks (2.5 ~ 3.3 V)	
15	GND	P	Ground	
16	GND	P	Ground	
17~22	NC	-	No connection	
23	LED_A	P	Backlight positive	
24	LED_A	P	Backlight positive	

说明： 1. 本产品默认为 3-line SPI



## 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 +4.0	
Operating Temperature	Top	°C	-20 to +70	
Storage Temperature	Tst	°C	-30 to +80	
Operating Humidity	Hop	%(RH)	90	

(VSS=0V)

### 4.2 Electrical characteristics (Ta=25°C)

**Table 4.2:DC Characteristic (Vcc = 3.0 ~ 3.6V)**

Item		Symbol	Condition	Min.	Type.	Max.	Unit
Supply Voltage	Logic	Vdd	---	2.5	2.8	3.3	V
Input Voltage	H level	V <sub>IH</sub>	---	0.7V <sub>VCI</sub>	---	V <sub>dd</sub>	V
	L level	V <sub>IL</sub>		0	---	0.2V <sub>VCI</sub>	
Current Consumption		I <sub>DD</sub>	With internal voltage generation; VDD=2.8V; Tamb=25°C;	---	---	---	mA



### 4.3 Back-light Specification

**Table 4.3 Back-light Characteristics**

Item	Symbol	Conditions	Min.	Type.	Max.	Unit
Supply Voltage	VF	Only Backlight	2.8	3.2	3.4	V
Supply Current	IF		60			mA
Average Brightness	IV	Backlight Current IF=60mA	-	5000	-	Cd/m <sup>2</sup>
CIE Color Coordinate (Without LCD)	X	Backlight Current IF=60mA	0.25	--	0.31	-
	Y		0.25	--	0.31	
Uniformity	B	Backlight Current IF=60mA	--	80%	-	%
Color	White					

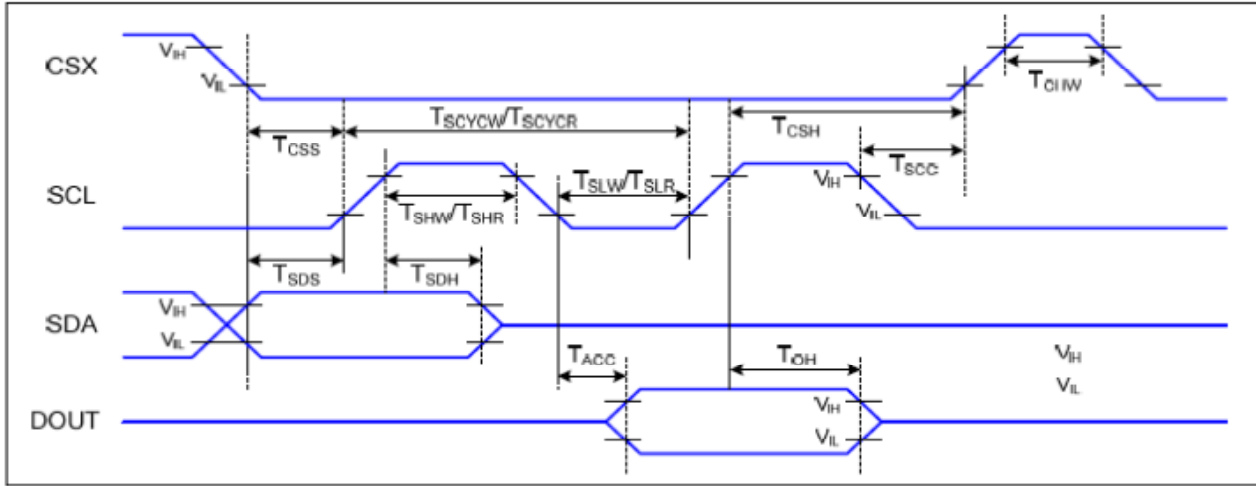
**Note:** 3 LEDs connection.





## 5. AC Characteristics

### 5.1 3-Line SPI Interface Characteristics

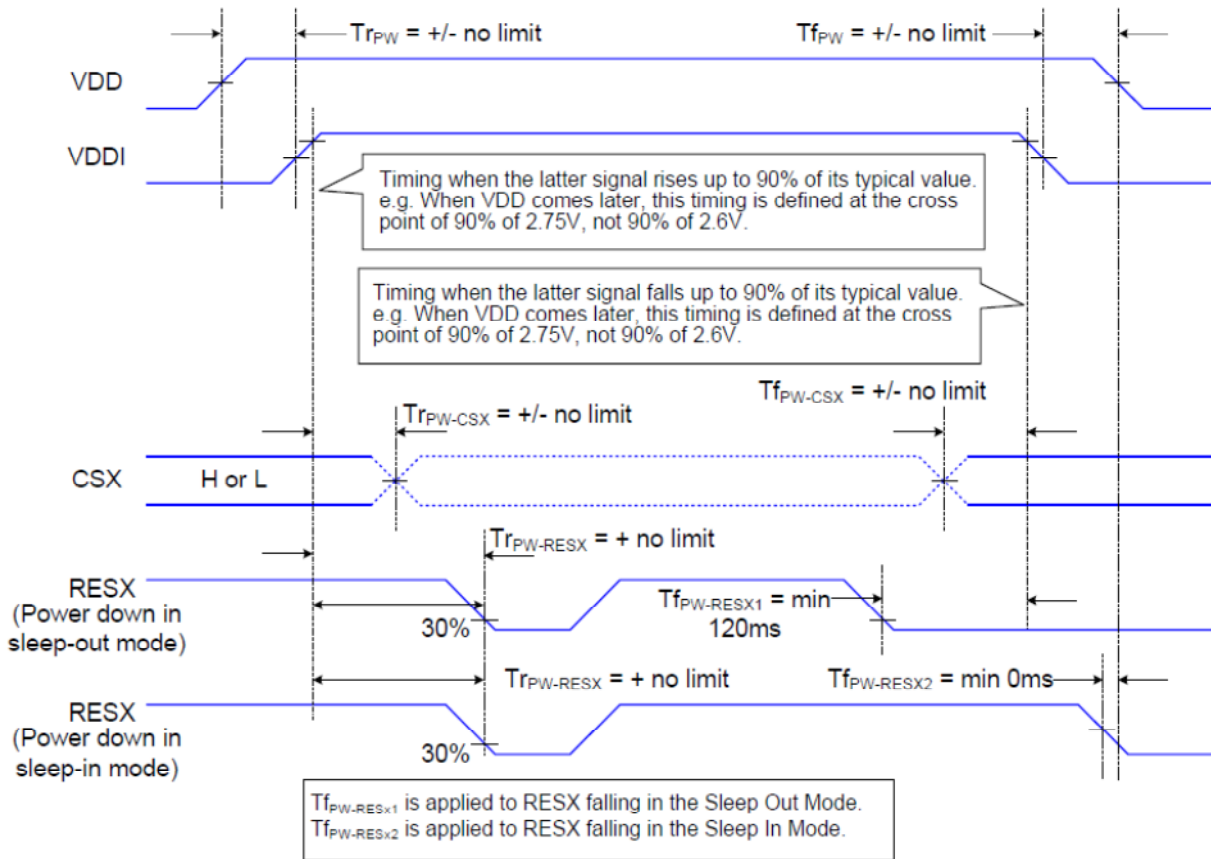


VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	$T_{CSS}$	Chip select setup time (write)	15		ns	
	$T_{CSH}$	Chip select hold time (write)	15		ns	
	$T_{CSS}$	Chip select setup time (read)	60		ns	
	$T_{SCC}$	Chip select hold time (read)	65		ns	
	$T_{CHW}$	Chip select "H" pulse width	40		ns	
SCL	$T_{SCYCW}$	Serial clock cycle (Write)	66		ns	
	$T_{SHW}$	SCL "H" pulse width (Write)	15		ns	
	$T_{SLW}$	SCL "L" pulse width (Write)	15		ns	
	$T_{SCYCR}$	Serial clock cycle (Read)	150		ns	
	$T_{SHR}$	SCL "H" pulse width (Read)	60		ns	
	$T_{SLR}$	SCL "L" pulse width (Read)	60		ns	
SDA (DIN)	$T_{SDS}$	Data setup time	10		ns	
	$T_{SDH}$	Data hold time	10		ns	
DOUT	$T_{ACC}$	Access time	10	50	ns	For maximum CL=30pF
	$T_{OH}$	Output disable time	15	50	ns	For minimum CL=8pF



## 6. Power On/Off Sequence





## 7. Optical Specification

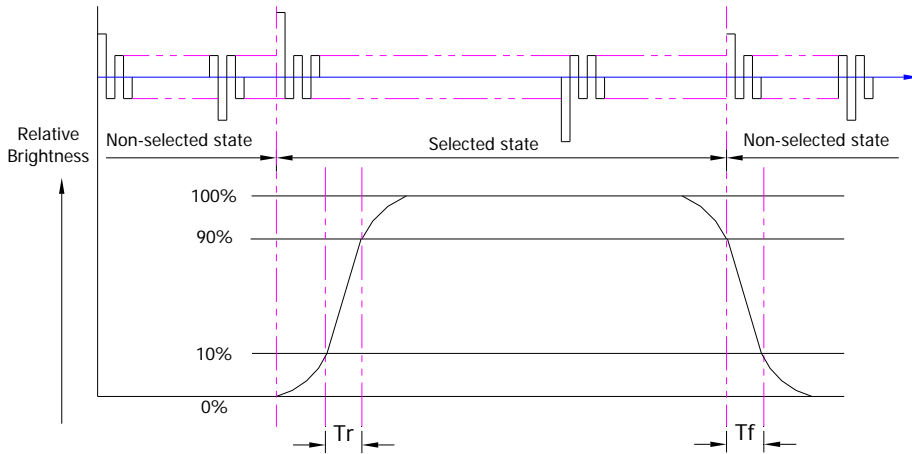
Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the TFT-LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to 0°.

	Item	Symbol	Condition	Specification			Unit
				Min.	Typ.	Max.	
Backlight On (Transmissive Mode)	Luminance on TFT( $I_f$ =20mA/LED)	L <sub>V</sub>	Normally viewing angle $\theta_x = \phi_y$ =0°	-	300	-	cd/m <sup>2</sup>
	Contrast ratio(See 7.2)	CR		-	900	-	
	Response time (See 7.1)	T <sub>R</sub> +T <sub>F</sub>		-	35	50	ms
	Chromaticity Transmissive (See 7.4)	White	X <sub>w</sub>	0.249	0.279	0.309	-
			Y <sub>w</sub>	0.277	0.307	0.337	-
	Viewing Angle (See 7.3)	Horizo ntal	$\theta_{x+}$	-	80	-	Deg.
			$\theta_{x-}$	-	80	-	
Vertic al		$\phi_{y+}$	-	80	-		
		$\phi_{y-}$	-	80	-		
	NTSC Ratio(Gamut) (See 7.4)	-	-	-	50	-	%



## 7.1 Definition of Response Time

### 7.1.1 Normally Black Type (Negative)

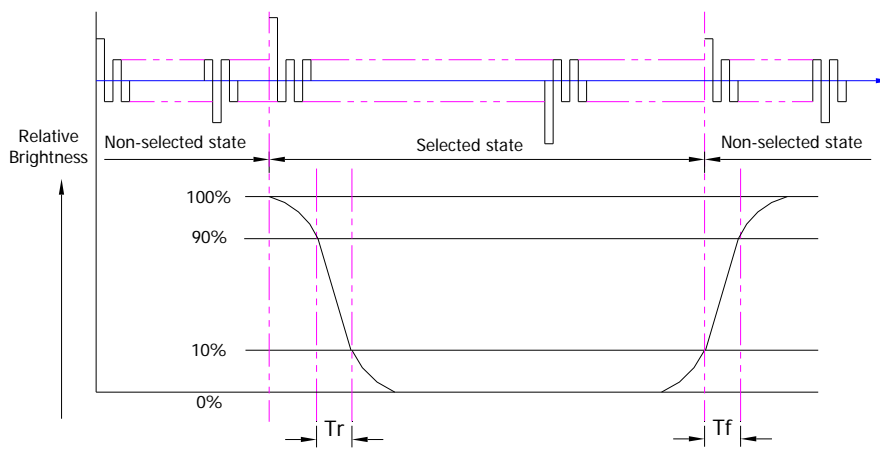


Tr is the time it takes to change from non-selected stage with relative luminance 10% to selected state with relative luminance 90%;

Tf is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

Note : Measuring machine: LCD-5100

### 7.1.2 Normally White Type (Positive)



Tr is the time it takes to change from non-selected stage with relative luminance 90% to selected state with relative luminance 10%;

Tf is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

Note : Measuring machine: LCD-5100 or EQUI

## 7.2 Definition of Contrast Ratio

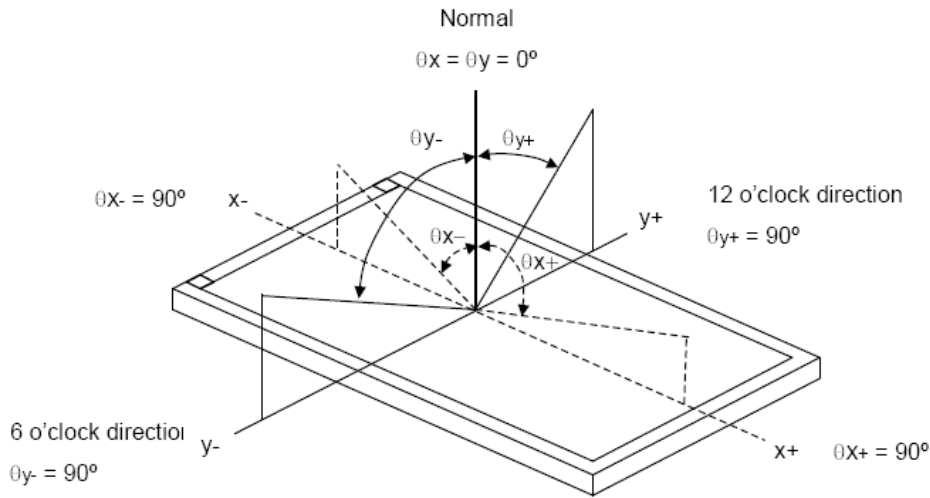
Contrast is measured perpendicular to display surface in reflective and transmissive mode. The measurement condition is:

Measuring Equipment	Eldim or Equivalent
Measuring Point Diameter	3mm//1mm
Measuring Point Location	Active Area centre point
Test pattern	A: All Pixels white
	B: All Pixel black
Contrast setting	Maximum

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel



### 7.3 Definition of Viewing Angles



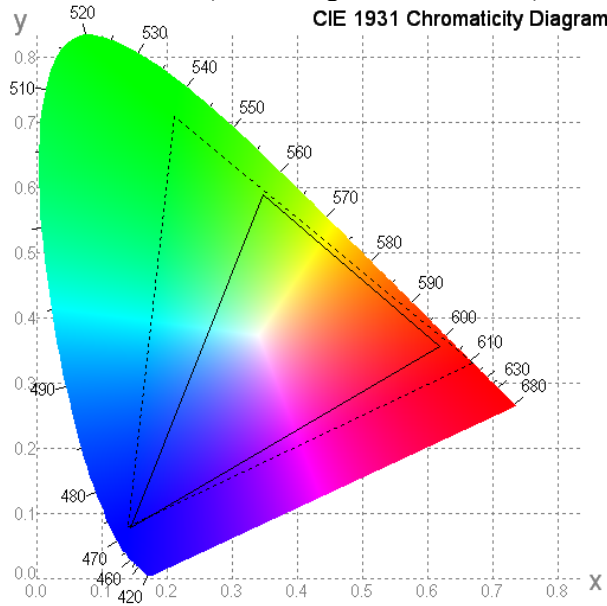
Measuring machine: LCD-5100 or EQUI

### 7.4 Definition of Color Appearance

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)





## 8. Reliability Test Items

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

### Reliability Test Criteria:

Display function should be no change under normal operating condition.

## 9. Handling Precautions

### 9.1 Use Restriction

This product is not authorized for use in life supporting systems, aircraft navigation control systems, military systems and any other application where performance failure could be life-threatening or otherwise catastrophic.

### 9.2 Disassembling or Modification

Do not disassemble or modify the LCD. It may damage sensitive parts inside LCD, and may cause scratches or dust on the display. HannStar does not warrant the LCD, if customers disassemble or modify the module.

### 9.3 Breakage of LCD Panel

9.3.1 If LCD panel is broken and liquid crystal spills out, do not ingest or inhale liquid crystal, and do not contact liquid crystal with skin.

9.3.2 If liquid crystal contacts mouth or eyes, rinse out with water immediately.

9.3.3 If liquid crystal contacts skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.

9.3.4 Handle carefully with chips of glass that may cause injury, when the glass is broken.

### 9.4 Absolute Maximum Ratings and Power Protection Circuit

9.4.1 Do not exceed the absolute maximum rating values, such as the supply voltage variation, input voltage variation, variation in parts' parameters, environmental temperature, etc., otherwise LCD may be damaged.

9.4.2 Please do not leave LCD in the environment of high humidity and high temperature for a long time.



9.4.3 It's recommended to employ protection circuit for power supply.

## 9.5 Operation

9.5.1 Do not touch, push or rub the polarizer with anything harder than HB pencil lead If the LCD attaches a polarizer.

9.5.2 Use fingerstalls of soft gloves in order to keep clean display quality, when persons handle the LCD for incoming inspection or assembly.

9.5.3 When the surface is dusty, please wipe gently with absorbent cotton or other soft material.

9.5.4 Wipe off saliva or water drops as soon as possible. If saliva or water drops contact with polarizer for a long time, they may causes deformation or color fading.

9.5.5 When cleaning the adhesives, please use absorbent cotton wetted with a little petroleum benzine or other adequate solvent.

## 9.6 Static Electricity

9.6.1 Protection film must remove very slowly from the surface of LCD to prevent from electrostatic occurrence if the LCD attaches a polarizer.

9.6.2 Because TFT-LCD panel is very weak to electrostatic discharge, please be careful with electrostatic discharge.

Persons who handle the LCD should be grounded through adequate methods.

## 9.7 Strong Light Exposure

The LCD shall not be exposed under strong light such as direct sunlight. Otherwise display characteristics may be changed.

## 9.8 Disposal

When disposing LCD, obey the local environmental regulations.



## 10 QC

### 10.1 Purpose

To ensure the stability of our product and standardize our inspection

### 10.2 Application Range

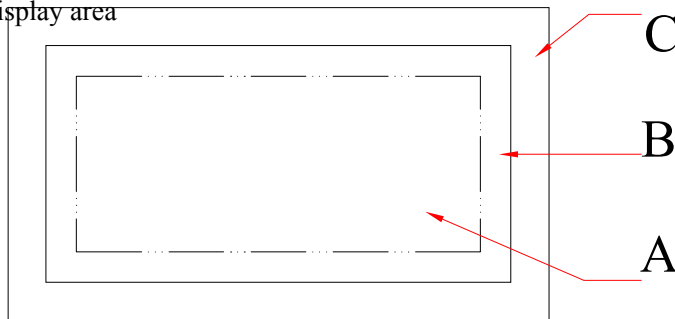
This standard is applied to all 4.3 inch and smaller sized LCM product from Elsun Technology Co.Ltd

### 10.3 Definition of inspection area

C area: The area covered after installation

B area: visible area

A area: display area

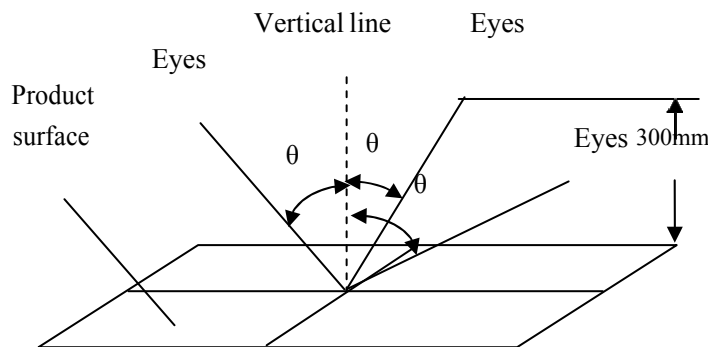


### 10.4 The environmental condition of inspection

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

Test ambient temperature should be  $23 \pm 5$  °C, humidity at  $50 \pm 20\%$  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

No	Inspection item	inspection criteria	defect grade
10.6.2.1	Dot defect black dot, white dot, dirt on surface, stain, bubble	1. dot defect identification:	Minor defect
		2. inspection criteria range	


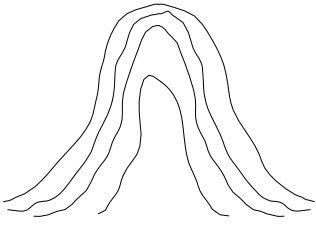
$$\Phi = \frac{(x+y)}{2}$$

Area and quantit y dimension(mm)	quantity allowed		
	A area	B area	C area
$\Phi \leq 0.15$	ignore		ignore
$0.15 < \Phi \leq 0.20$	2 (spacing $\geq 10\text{mm}$ )		
$0.20 < \Phi \leq 0.3$	1		
$\Phi > 0.3$	0		



No	Inspection item	inspection criteria	defect grade					
10.6.2.2	line defect visible black/white line	1. identification of line dimension  L: length W: width	Minor defect					
		2. inspection criteria						
		dimension(mm)		quantity allowed ( total 3 pcs )				
		L ( length )		W ( width )	area			
					A area	B area	C area	
		ignore		$W \leq 0.03$	ignore		ignore	
		$L \leq 3.0$		$0.03 < W \leq 0.05$	2			
		$L \leq 3.0$		$0.05 < W \leq 0.08$	1			
	$W > 0.08$	count according to dot defect						
10.6.2.3	scratch	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	Minor defect					
		dimension ( mm )		Quantity allowed				
		L ( length )		W ( width )	area			
					A	B	C	
		ignore		$W \leq 0.03$	ignore			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			
	$W > 0.08$	Not allowed						



No	Inspection item	inspection criteria	defect grade
10.6.2.4	Glass defect	1. broken angle  X不计 Y≤2.0mm or X≤2.0mm Y不计 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 Newtonringarea≤1/2T/Parea,anddoesn'taffectthe displayresult andwitouthlinedistortion;acceptable	Minor defect



NO	Inspection item	inspection criteria	defect grade
10.6.2.6	FPC	<ol style="list-style-type: none"> <li>1. copper foil off, warping, crack and oxidation are not allowed</li> <li>2. FPC crack, break, serious scratch and crease are not allowed</li> </ol>	main defect
		<ol style="list-style-type: none"> <li>3. if no special requirements, no release paper on double-sided adhesive FPC is not allowed.</li> <li>4. Slight creases and scratches not exposed from the copper foil and with no affect to appearance and function are allowed.</li> <li>5. if no special requirements, no insulating tape at welding part on backlight and touch-screen is not allowed..</li> <li>6. Parts off, breakage and deform are not allowed.</li> <li>7. print on the surface should be clear and correct.</li> </ol>	Minor defect
10.6.2.7	basic appearance requirements	<ol style="list-style-type: none"> <li>1. clean appearance, no dirt, fingerprints and other traces.</li> <li>2. ITO circuit on COG coating area should not be exposed.</li> <li>3. Rust, sever scratch, deformation, obvious burrs and color dirt are not allowed.</li> <li>4. Mis-assembly, part missing are not allowed.</li> <li>5. Bubble caused by mis-pasted polaroid refers to 10.6.2.1</li> <li>6. For watermark, the criteria is upon agreed by both parties.</li> </ol>	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	<ol style="list-style-type: none"> <li>one dot is acceptable.</li> <li>Under bright status, 2 dark dots with more than 5mm distance is allowed.</li> <li>Totally 2 bright or dark dots are acceptable.</li> <li>The other defect under bright status refers to 10.6.2.1</li> </ol> <p>Note: Electric bright/dark dot means one pixel; less than 1/2 of 1 pixel can be ignored.</p>	Minor defect
10.6.3.4	connected dot/line defect	<ol style="list-style-type: none"> <li>Two continuous defect pixel connected dots are not allowed.</li> <li>Line defect refers to 10.6.2.2</li> </ol>	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	<ol style="list-style-type: none"> <li>Backlight off are not allowed.</li> <li>Uneven light, dead light, flicker light, dark angle, light leakage are not allowed.</li> <li>Brightness should comply with drawing</li> </ol>	main defect

end.