SPECIFICATION FOR LCD MODULE

Part No.:	MLT013G12-3
Customer No.:	
Spec Version:	01
Issued Date:	2019.9.3
Customer approval:	

Designed 设计者	Checked 审核者	Approved 核准者

※Please pay more attention for the “inspection standard”, we assume you already agree this standard when place an order with us.

※The specification of “TBD” should refer to the measured value of sample .

Documents Revision History:

Rivision	Date	Description	Changed By
01	2019/9/3	New released	John

1. General Description

- The MLT013G12-3 model is a Color TFT LCD supplied by Maclight Display Co Ltd.
- This main Module has a 1.28 inch diagonally measured active display area with 240(RGB)X240 resolution. Each pixel is divided into Red, Green and Blue sub-pixels and dots, which are arranged in vertical stripes.
- The MLT013G12-3 has been designed to enables high brightness, high speed, and high contrast.

2. Mechanical Specification

ITEM	Standard Value	Unit
LCD Size	1.28 inch(Diagonal)	--
Display Mode	Normally Black, Transmissive LCD	--
Module Dimension	35.60(W)*38.10(H)*1.55(T)	mm
Resolution	240(RGB)X 240	Pixels
Active Display Area	32.40(W)×32.40(H)	mm
Pixel pitch	0.135(W) × 0.135(H)	mm
Input Data	4 Line SPI	--
Viewing Direction	All	--
LED Backlight Color	White LEDx2	--
Driver IC	GC9A01	--

3. Electrical Specification

■ Absolute Maximum Rating (Ta=25 VSS=0V)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Supply Voltage (I/O)	VDD	-0.3	4.6	V	
Analog Supply Voltage	VDDIO	-0.3	4.6	V	
Logic Input Voltage	VIN	0.3	VDDIO+0.5	V	
Operating temperature	TOP	-20	70	℃	
Storage temperature	TST	-30	80	℃	

■ DC Electrical Characteristics

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
System Voltage	VDD	2.5	2.8	3.3	V	
Gate Driver High Voltage	VGH	12	–	13	V	
Gate Driver Low Voltage	VGL	-11	–	-8	V	
Operating Current for VDD	IDD	--	8.5	10.5	mA	
Sleep_In Mode VDD	Idd	–	15	30	uA	
Sleep_In Mode VDDIO	I_{ddio}	–	5	10	uA	

■ Backlight Characteristics

The back-light system is edge-lighting type with 2 chips White LED

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED backlight	VLED	2.9	3.0	3.1	V	
Current for LED backlight	ILED	--	40	60	mA	
LCM Luminance	Lv	350	400	--	Cd/m2	
LED life time	HR	20000	--	--	Hour	
Power Consumption	Pbl	--	120	186	mW	

Note:

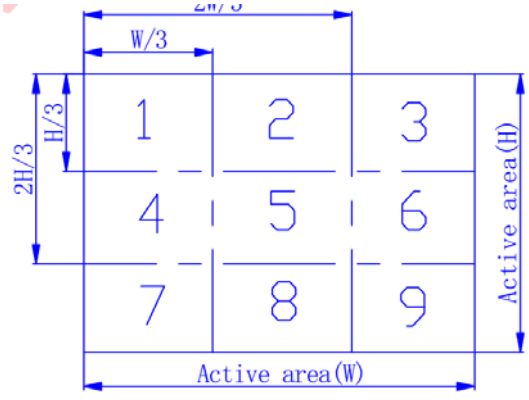
1. Where ILED =40mA , VLED=3.0V , Pbl= ILED x VLED

2. Uniform measure condition:

a:Measure 9 point,Measure location is show below:

b:Uniform=(Min brightness/Max.brightness)x100%

c:Best Contrast



3. The environmental conducted under ambient air flow ,at Ta=25±2oC,60%RH±5%

4. Optical Specification

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Viewing angle (CR≥ 10)	θ_L	Φ=180°(9 o'clock)	80	85	-	degree	
	θ_R	Φ=0°(3 o'clock)	80	85	-		
	θ_T	Φ=90°(12 o'clock)	80	85	-		
	θ_B	Φ=270°(6 o'clock)	80	85	-		
Response time	T_{ON}	Normal θ=Φ=0°	-	10	20	msec	
	T_{OFF}		-	15	30	msec	
Contrast ratio	CR		900	1100	-	-	
Color chromaticity	W_X		0.27	0.32	0.37	-	
	W_Y		0.29	0.34	0.39	-	
Luminance	L		300	350	-	cd/m²	
Luminance	Y_U		70	75	-	%	

Note.1 These items are measured by C light.
Note.2 Definition of Viewing Angle(θ,ψ),refer to Fig.1 as below：

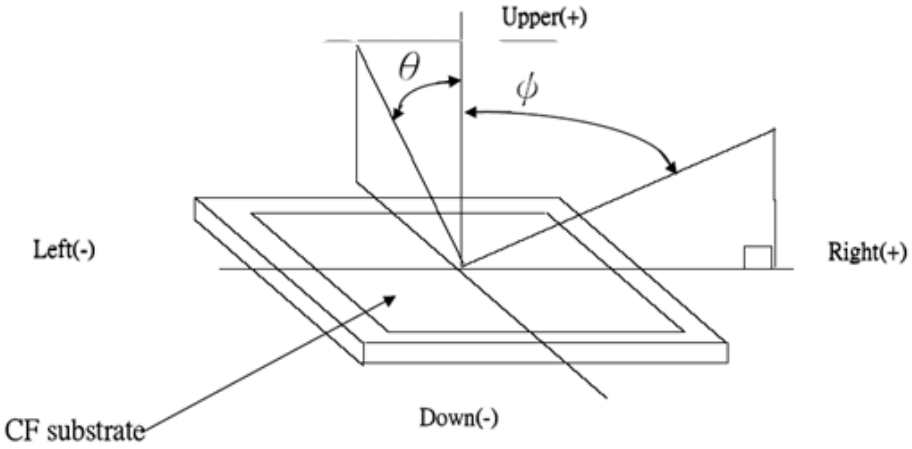
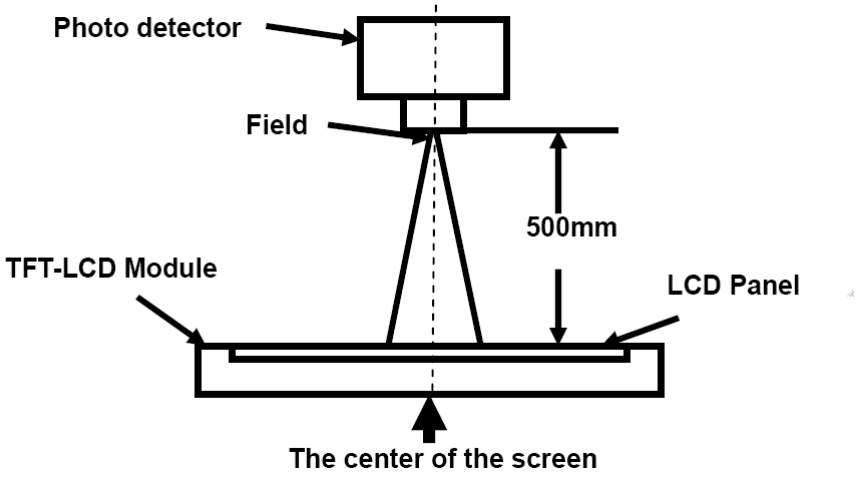


Fig.1 Definition of Viewing Angle

Note.3 Using LC+ EWV Polarizer+Corresponding Backlight, reference only, Measure device：BM-5A (TOPCON)，viewing cone= 1°，I_L=20mA。

Electro-optical characteristics test method:



Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

“White state “:The state is that the LCD should driven by Vwhite.

“Black state”: The state is that the LCD should driven by Vblack.

Vwhite: To be determined

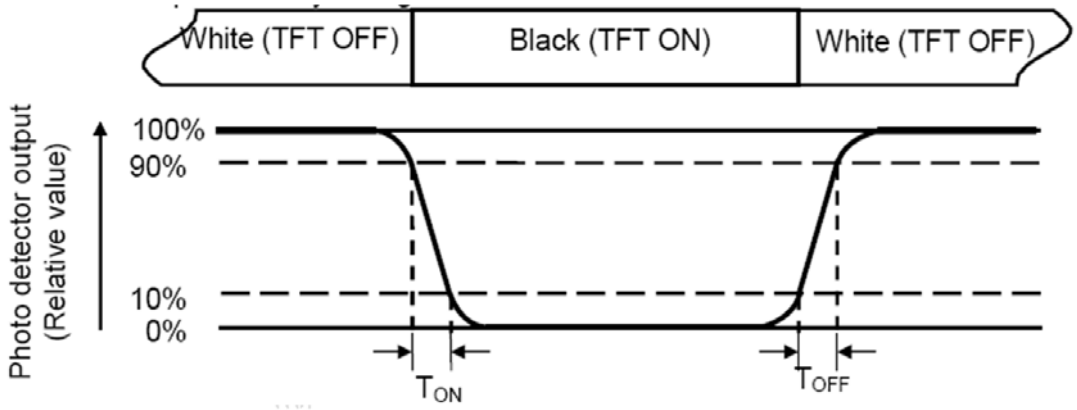
Vblack: To be determined.

Definition of Response Time:

The response time is defined as the LCD optical switching time interval between “White” state and

“Black” state. Rise time (TON) is the time between photo detector output intensity changed from

90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from10% to 90%.



Definition of color chromaticity (CIE1931)

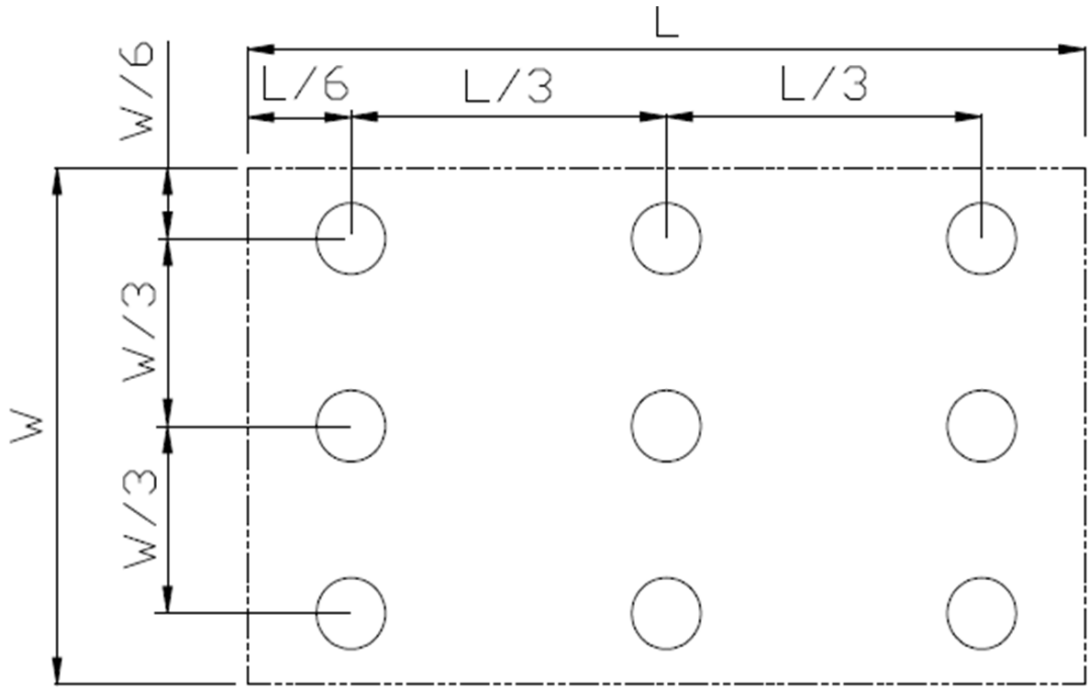
Color coordinates measured at center point of LCD

Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = Lmin/ Lmax

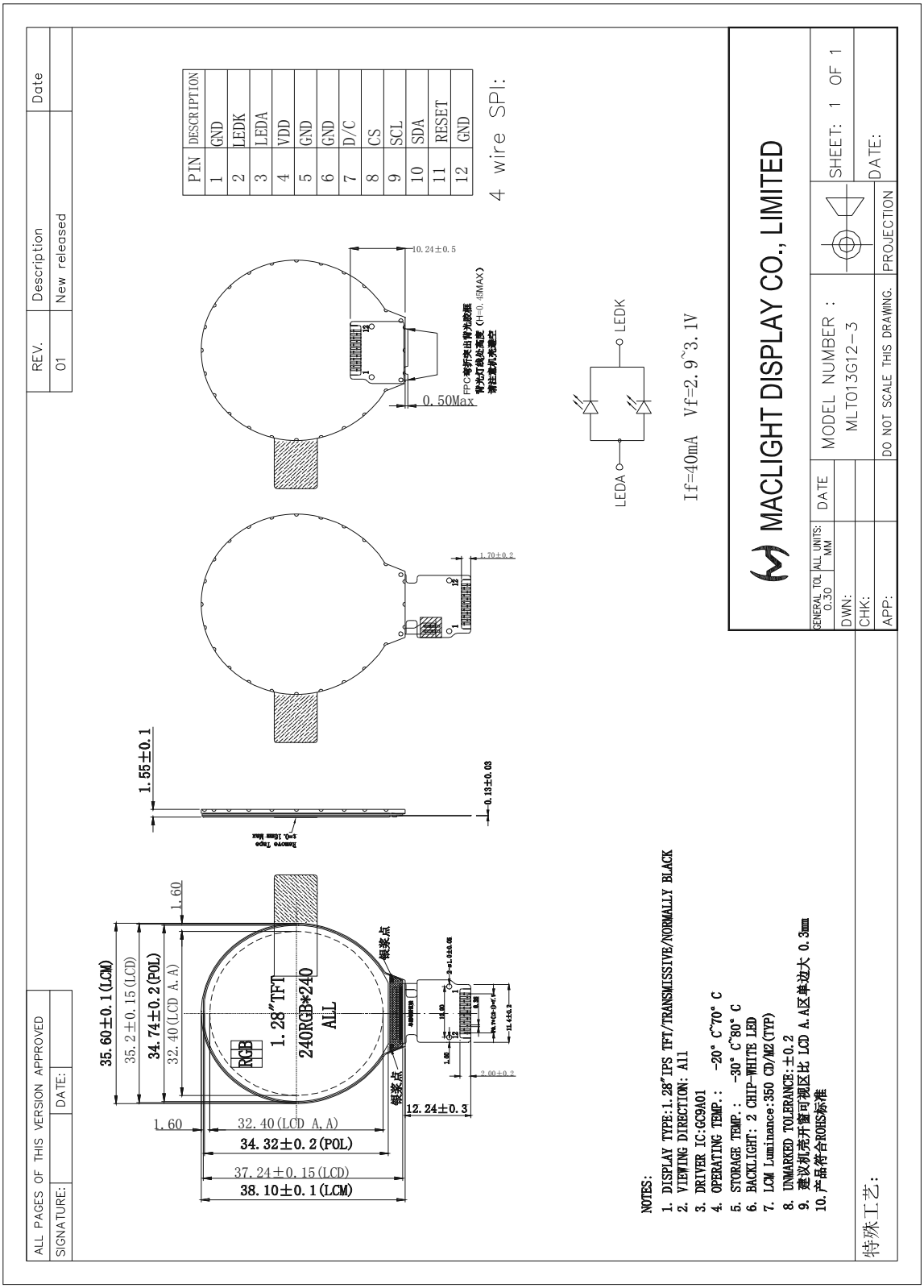
L-------Active area length W----- Active area width



Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.

5. Mechanical Diagram

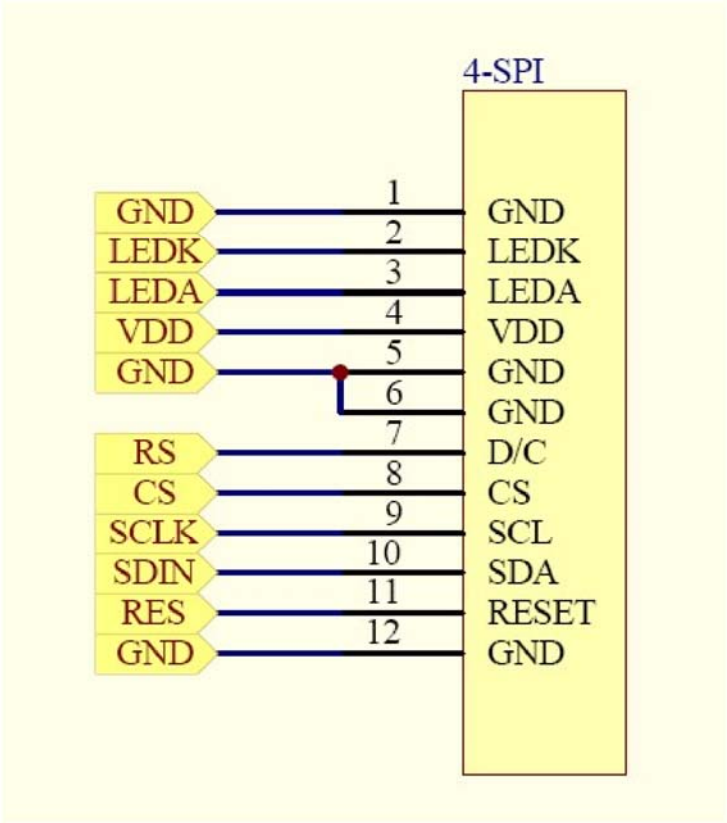


6. Interface Pin Connections

FPC Connector is used for the module electronics interface.

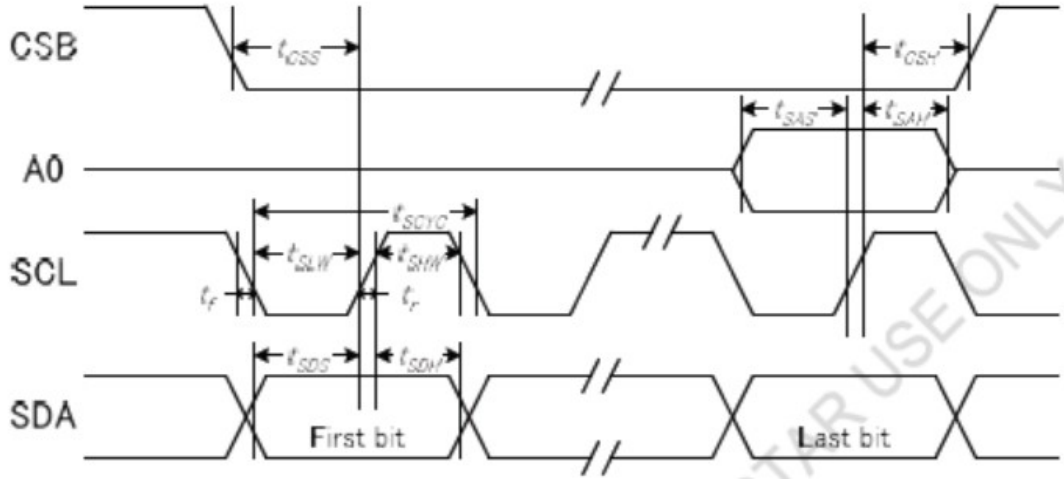
NO.	Symbol	Description
1	GND	Power Ground
2	LEDK	LED Cathode
3	LEDA	LED Anode
4	VDD	Power Supply for Analog
5	GND	Power Ground
6	GND	Power Ground
7	D/C	Display data/command selection pin in 4-line serial interface.
8	CS	Chip selection pin;Low enable,high disable.
9	SCL	This pin is used to be serial interface clock
10	SDA	SPI interface input/output pin. the data is latched on the rising edge of the SCL signal.
11	RESET	This signal will reset the device and it must be applied to properly initialize the chip. Signal is active low.
12	GND	Power Ground

Note:



7. Timing

7.1 AC Timing Characteristic of The LCD



Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCL	tSCYC		30	—	ns
SCLK "H" pulse width		tSHW		15	—	
SCLK "L" pulse width		tSLW		15	—	
Address setup time	A0	tSAS		10	—	
Address hold time		tSAH		10	—	
Data setup time	SDA	tSDS		10	—	
Data hold time		tSDH		10	—	
CSB-SCLK time	CSB	tCSS		10	—	
CSB-SCLK time		tCSH		10	—	

Note:

1. The input signal rise and fall time (tr, tf) are specified at 15 ns or less.
2. All timing is specified using 20% and 80% of VDDI as the standard.

8. Inspection Criterion

A. Sampling Method

Unless otherwise agreed upon in writing, the sampling inspection shall be applied to theCustomer's incoming inspection.

1) Lot size: Quantity per shipment lot
2) Sampling type: Normal inspection , single sampling
3) Inspection level: Ⅱ
4) Sampling table: MIL-STD-105D
5) Acceptable Quality Level(AQL): Major=0.65Minor=1.5

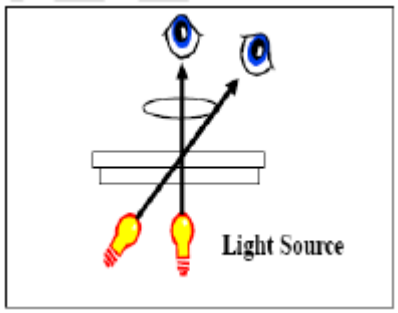
B. Inspection Method

1) Ambient Condition:
   a. Temperature: Room temperature 25±5℃
   b. Illumination: Single fluorescent lamp non-directive(300 to 700 Lux)
2) Viewing distance

The distance between the LCD and the inspector's eyes shall be at least 30-50cm.

3) Viewing Angle

The inspection shall be conducted within normal viewing angle range.



9. Inspection Criteria

1) Major defect

NO.	Item	Inspection Standard	Classification defect
1	All function defect	No display Display abnormal Short circuit Missing segment Excess power consumption No backligt, flickering	Major
2	missing	Missing compement	Major

3	Outline dimension	Outline Dimension out of drawing tolerance	Major

2) Cosmetic defect

A. Definition of inspection range

For dot defect of TFT LCD which is not smaller than 3 inches, dividing three areas to make a judgment (according to figure 1).

A area : center of viewing area

B area : periphery of viewing area

C area : Outside viewing area

For other defects, dividing two areas to make a judgment (according figure 2).

A zone : Inside Viewing area

B zone : Outside Viewing area

X1(A.A~V.A): 2mm X2(A.A~V.A): 2mm

Y1(A.A~V.A): 2mm Y2(A.A~V.A): 2mm

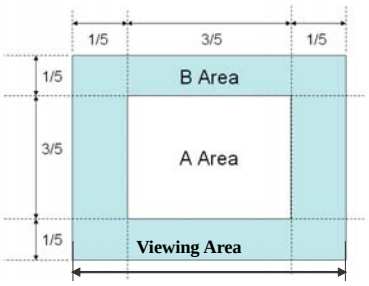


Figure 1

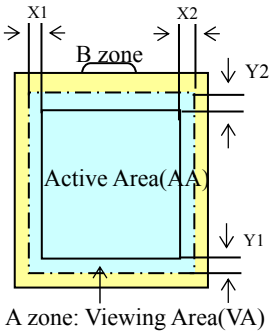
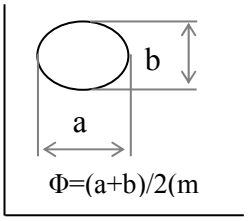


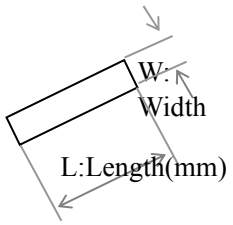
Figure 2

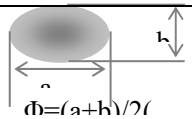
B. **Cosmetic defect criteria**

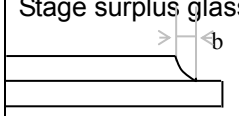
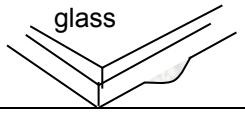
<table>
<tr><td colspan="3" rowspan="3">Inspection items</td><td colspan="5">Judgment standard</td></tr>
<tr><td colspan="3" rowspan="2">Category</td><td colspan="2">Acceptable number</td></tr>
<tr><td>A zone</td><td>B zone</td></tr>
<tr><td rowspan="6">1</td><td rowspan="6">Black spot, White spot, Bright Spot,

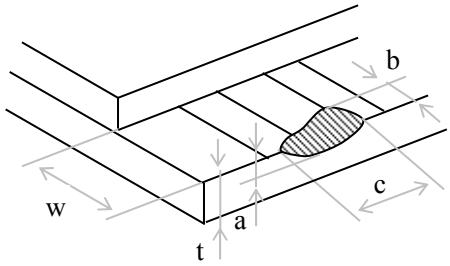
Pinhole, Foreign

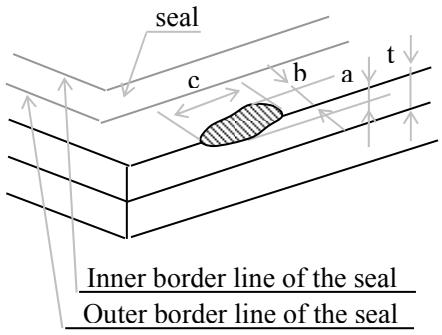
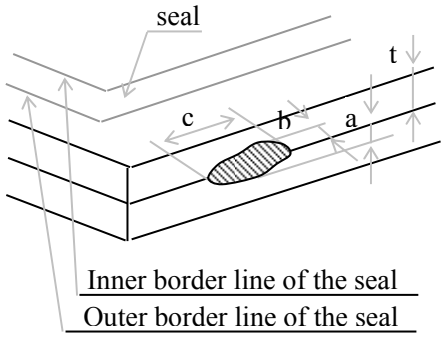
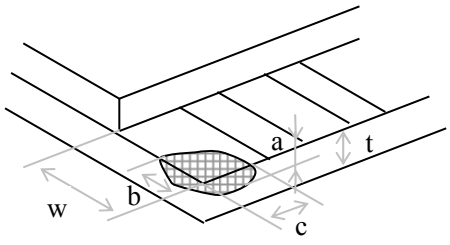
Particle, Particle in or on glass, Scratch on glass</td><td rowspan="6">  </td><td>A</td><td>Φ≦0.10</td><td>Neglected</td><td rowspan="5">Neglected</td></tr>
<tr><td>B</td><td>0.10<Φ≦0.15</td><td>2</td></tr>
<tr><td>C</td><td>0.15<Φ≦0.20</td><td>1</td></tr>
<tr><td>D</td><td>0.20<Φ</td><td>0</td></tr>
<tr><td colspan="2">Total defective point(B,C)</td><td>3</td></tr>
<tr><td rowspan="5">2</td><td rowspan="5">Black line, White line, and Particle Between

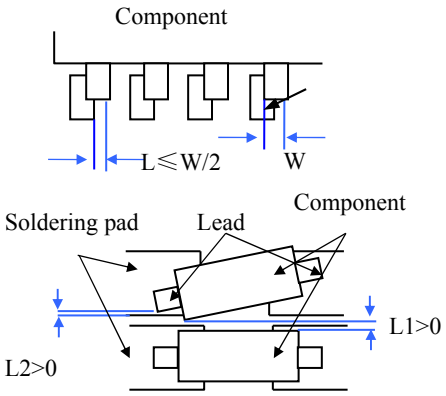
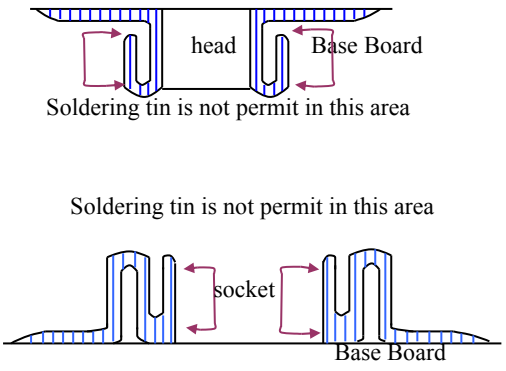
Polarizer and glass, Scratch on glass</td><td rowspan="5">  </td><td>A</td><td>W≦0.01</td><td>Neglected</td><td rowspan="4">Neglected</td></tr>
<tr><td>B</td><td>0.01<W≦0.03 L≦3.0</td><td>2</td></tr>
<tr><td>C</td><td>0.03<W≦0.05 L≦3.0</td><td>1</td></tr>
<tr><td>D</td><td>0.05<W</td><td>0</td></tr>
<tr><td colspan="2">Total defective point(B,C)</td><td>3</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">Contrast

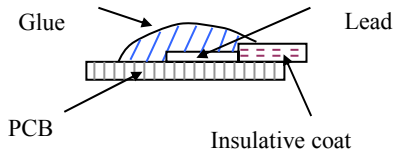
variation</td><td rowspan="5">  </td><td>A</td><td>Φ≦0.2</td><td>Neglected</td><td rowspan="4">Neglected</td></tr>
<tr><td>B</td><td>0.2<Φ≦0.3</td><td>2</td></tr>
<tr><td>C</td><td>0.3<Φ≦0.4</td><td>1</td></tr>
<tr><td>D</td><td>0.4<Φ</td><td>0</td></tr>
<tr><td colspan="2">Total defective point(B,C)</td><td>3</td><td></td></tr>
<tr><td rowspan="11">4</td><td rowspan="11">Dot defect (if TFT LCD is used)</td><td rowspan="6">TFT LCD is smaller than 3 inches</td><td>LCD Class</td><td>Defect</td><td colspan="2">A area</td><td>B area</td></tr>
<tr><td rowspan="3">A</td><td>Bright dot</td><td colspan="2">1</td><td rowspan="6">Neglected</td></tr>
<tr><td>Dark dot</td><td colspan="2">2</td></tr>
<tr><td>Total</td><td colspan="2">2</td></tr>
<tr><td rowspan="3">B</td><td>Bright dot</td><td colspan="2">2</td></tr>
<tr><td>Dark dot</td><td colspan="2">3</td></tr>
<tr><td>Total</td><td colspan="2">4</td></tr>
<tr><td rowspan="5">TFT LCD between 3~10.4 inches</td><td>LCD Class</td><td>Defect</td><td>A area</td><td>B area</td><td>C area</td></tr>
<tr><td rowspan="2">A</td><td>Bright dot</td><td>1</td><td>1</td><td rowspan="5">Neglected</td></tr>
<tr><td>Dark dot</td><td>1</td><td>2</td></tr>
<tr><td>Total</td><td colspan="2">4</td></tr>
<tr><td rowspan="3">B</td><td>Bright dot</td><td>2</td><td>2</td></tr>
<tr><td>Dark dot</td><td>2</td><td>3</td></tr>
<tr><td>Total</td><td colspan="2">6</td></tr>
</table>

		Notes: Bright dot: in R、G、B or dark display figure, the pixel appears bright. Dark dot: in R、G、B or white display figure, the pixel appears dark. Defect area must be less than an half size of the dot.				
5	Bubble inside cell		any size		none	none
6	Polarizer defect (if Polarizer is used)	Scratch ,damage on polarizer, Particle on polarizer or between polarizer and glass.	Refer to item 1 and item 2.			
		Bubble, dent and convex	A	Φ≦0.3	Neglected	Neglected
			B	0.3<Φ≦0.7	2	
			C	0.7<Φ	0	
7	Surplus glass	Stage surplus glass 	b≦0.3mm			
		Surrounding surplus glass 	Should not influence outline dimension and assembling.			
11	Contrast ratio uneven		According to the limit specimen			
12	Crosstalk		According to the limit specimen			
13	Black /White spot(display)		Refer to item 1			
14	Black /White line(display)		Refer to item 2			

Inspection items			Judgment standard		
			Category(application: B zone)		Acceptable number
15	Glass defect crack	①The front of lead terminals 	A	a≤ t, b≤1/5W, c≤3mm	Max.3 defects allowed
			B	Crack at two sides of lead terminals should not cover patterns and alignment mark	

		②Surrounding crack—non-contact side  	b < Inner borderline of the seal		
		③ Surrounding crack— contact side  	b < Outer borderline of the seal		
		④Corner  	A	a ≦ t, b ≦ 3.0, c ≦ 3.0	
			B	Glass crack should not cover patterns u and alignment mark and patterns.	

Inspection items			Judgment standard Category(application: B zone)
16	PCB defect	Component soldering: No cold soldering、short、open circuit、burr、tin ball The flat encapsulation component position deviation must be less than 1/3 width of the pin (Pic.1)； the sheet component deviation: Pin deviates from the pad and contact with the near components is not permitted（Pic.2）	
		lead defect: The lead lack must be less than 1/3 of its width; The lead burr must be less than 1/3 of the seam; Impurities connect with the near leads is not permitted	
		Connector soldering: Soldering tin is at contact position of the plug and socket is not permitted No foundation is scald Serious cave distortion on plug and socket contact pin is not permitted	

		Glue on root of the speaker receiver and motor lead: The insulative coat of the lead must join into the PCB; the protected glue must envelop to the insulative coat.	

10. Precautions for Use of LCD Modules

10.1 Handling Precautions

10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

10.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

— Isopropyl alcohol

— Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

— Water

— Ketone

— Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

10.1.7 If the logic circuit power is off, do not apply the input signals.

10.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

a. Be sure to ground the body when handling the LCD Modules.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

10.2 Storage precautions

10.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃

Relatively humidity: ≤80%

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.2.4 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.