

SPECIFICATION FOR LCD MODULE

Part No.:	MLT009G8-01
Customer No.:	
Spec Version:	01
Issued Date:	2020.1.6
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:

Revision	Date	Description	Changed By
01	2020/1/6	New released	

1. General Description

- The MLT009G8-01 model is a Color TFT LCD supplied by Maclight Display Co Ltd.
- This main Module has a 0.96 inch diagonally measured active display area with 80(RGB)X160 resolution. Each pixel is divided into Red, Green and Blue sub-pixels and dots, which are arranged in vertical stripes.
- The MLT009G13-06 has been designed to apply the parallel interface method that enables low power, high speed, and high contrast.

2. Mechanical Specification

ITEM	Standard Value	Unit
Display Size	0.96 inch(Diagonal)	
Display Mode	Normally black, Transmissive LCD	
Module Dimension	13.5(W)*27.95(H)*1.5(T)	mm
Resolution	80(RGB)X 160	Pixels
Active Display Area	10.8(W)×21.7 (H)	mm
Dot Pitch	0.135(W) x 0.1356(H) mm	
Viewing Direction	All	--
LED Backlight Color	White LEDx1	--
Driver IC	ST7735S	
Interface	4 Line SPI	--

3. Absolute Max Ratings & Electrical Specification

■ Absolute Max Rating

Item	Symbol	Min.	Max	Unit	Remark
Supply Voltage(IO)	VDD	-0.3	4.6	V	
Analog Supply Voltage	VDDIO	-0.3	4.6	V	
Logic Input Voltage	VIN	-0.3	VDD+0.3	mA	
Operating Temperature	Top	-20	70	°C	
Storage temperature	Tst	-30	80	°C	

Note:

*1) Liquid Crystal driving voltage.

Due to the characteristics of LC Material, this voltage vary with environmental temperature.

*2) Temp.>60℃, Absolute humidity shall be less than 90%RH at 60℃

*3) Temp.≤60℃, 90%RH MAX.

*4) The recommended operating conditions refer to a range in which operation of this product is guaranteed. Should this range is exceeded, the operation cannot be guaranteed even if the values may be without the absolute maximum ratings.

Accordingly, please make sure that the module is used within this range.

And these current values are measured under the condition that all devices are stopped, each component is stable and logic signal is input.

■ Model Characteristics

Item	Symbol	Min.	Typ	Max	Unit	Remark
Voltage for LED backlight	V _{BL}	2.9	3.0	3.1	V	
Supply Voltage for Logic	V _{DD}	2.5	2.8	3.3	V	
Interface Operation Voltage	V _{DDIO}	1.65	1.8	3.3	V	
Gate Driver High Voltage	V _{GH}	10	--	15	V	
Gate Driver Low Voltage	V _{GL}	-13	--	-7.5	V	
Operating Current for V _{DD}	I _{DD}	--	2	3	mA	
Current for LED backlight	I _{BL}	15	--	20	mA	Per LED
Sleep In Mode V _{DD}	I _{DD}	--	15	30	uA	
Sleep In Mode V _{DDIO}	I _{DDIO}	--	5	10	uA	

1)Test condition is:

a:Center point on active area

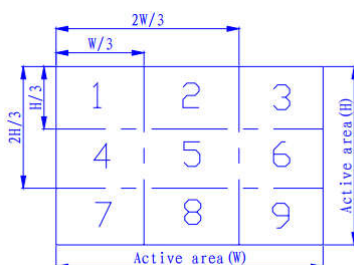
b:Best Contrast

2) Uniform measure condition:

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

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

c:Best Contrast.



4. Optical Specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp	$\theta=0^\circ$	350	400	-	cd/m ²	
Uniformity	ΔBp	$\Phi=0^\circ$	70	75	-	%	
Viewing Angle	θ_1	12 o'clock	-	80	-	Deg	Cr $\geq$ 10
	($\Phi=90^\circ$ or 270°)	6 o'clock	-	80	-		
	θ_2	9 o'clock	-	80	-		
	($\Phi=0^\circ$ or 180°)	3 o'clock	-	80	-		
CIE	Wx	$\theta=0^\circ$	0.26	0.31	0.36		
	Wy		0.28	0.33	0.38		
Contrast Ratio	Cr	$\Phi=0^\circ$	-	800		-	
Response Time	t _{on}		-	30	40	ms	
	t _{off}		-			ms	

Note.1 These items are measured by C light.

Note.2 Definition of Viewing Angle(θ, ψ), refer to Fig.1 as below :

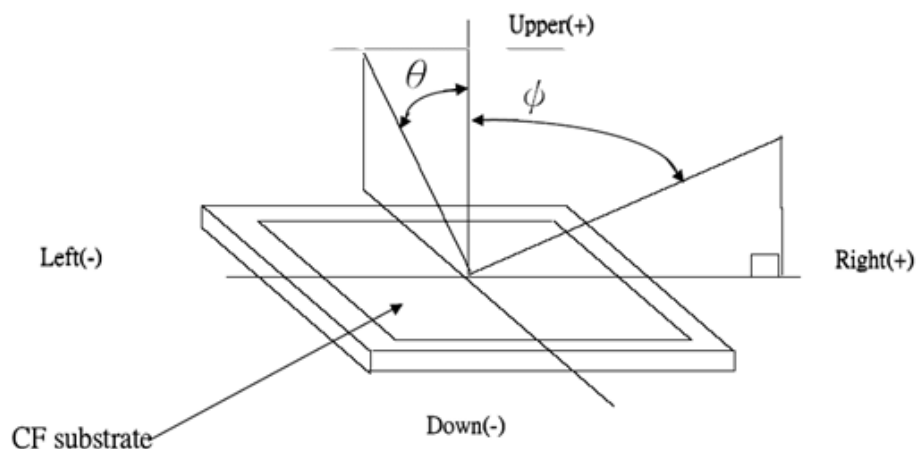
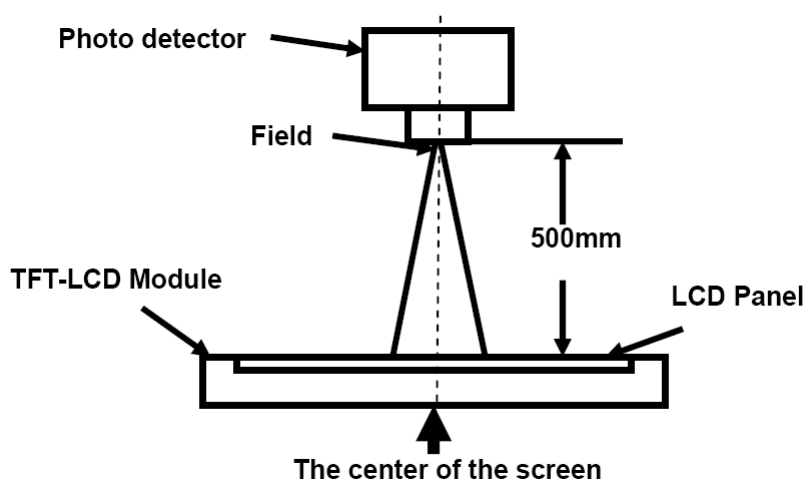


Fig.1 Definition of Viewing Angle

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

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

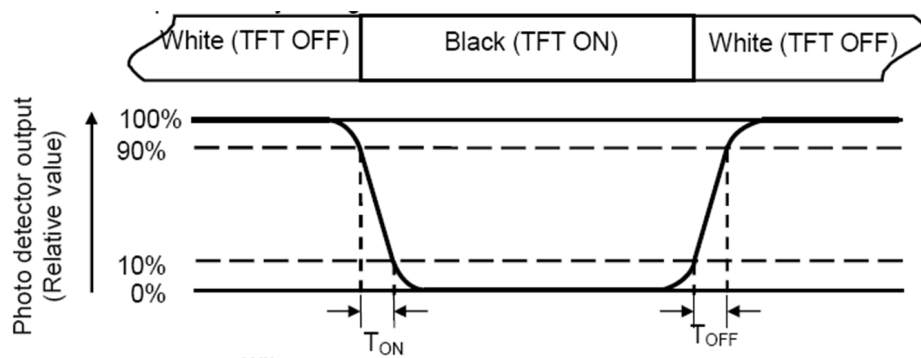
Vblack: To be determined.

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 from 10% to 90%.



Definition of color chromaticity (CIE1931)

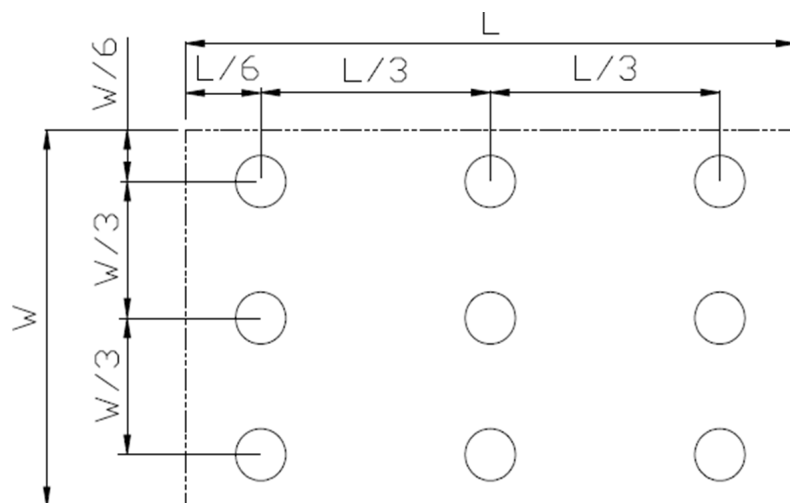
Color coordinates measured at center point of LCD

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.

$$\text{Luminance Uniformity}(U) = L_{\min} / L_{\max}$$

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



$L_{\max}$: The measured maximum luminance of all measurement position.

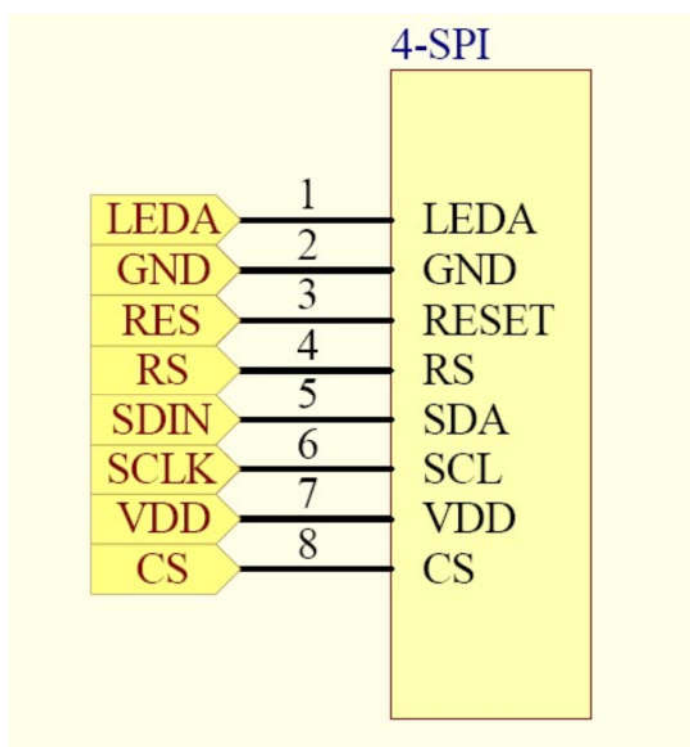
$L_{\min}$: The measured minimum luminance of all measurement position.

6. Interface Pin Connections

FPC Connector is used for the module electronics interface.

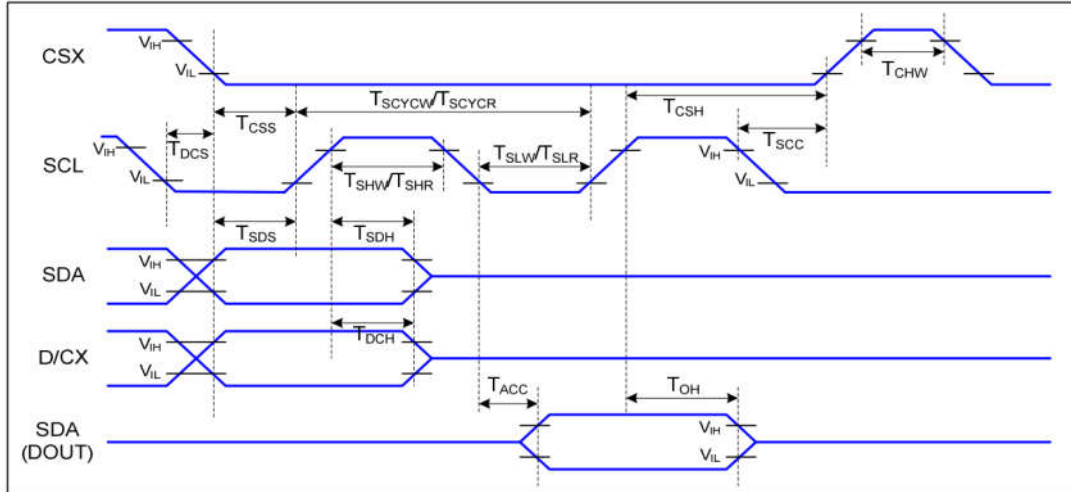
NO.	Symbol	Description
1	LED A	LED Anode
2	GND	Power Ground.
3	RESET	This signal will reset the device, Signal is active low.
4	RS	Display data/command selection pin in 4-line serial interface.
5	SDA	SPI interface input/output pin.
6	SCL	This pin is used to be serial interface clock.
7	VDD	Power Supply for Analog
8	CS	Chip selection pin, Low enable, High disable.

Note:



7. Timing Characteristics

7.1 Serial Interface Characteristics (4-line Serial)



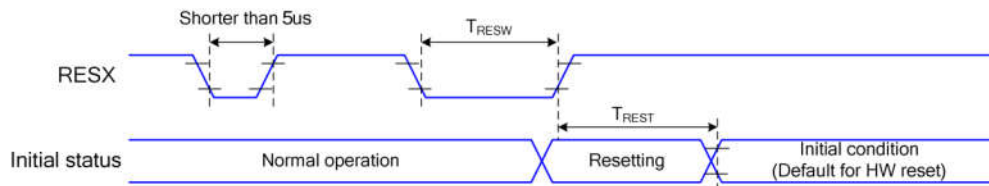
Ta=25 °C, VDDI=1.65~3.7V, VDD=2.3~4.8V

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip Select Setup Time (Write)	TBD		ns	
	TCSH	Chip Select Hold Time (Write)	TBD		ns	
	TCSS	Chip Select Setup Time (Read)	TBD		ns	
	TSCC	Chip Select Hold Time (Read)	TBD		ns	
	TCHW	Chip Select "H" Pulse Width	TBD		ns	
SCL	TSCYCW	Serial Clock Cycle (Write)	TBD		ns	-Write Command & Data Ram
	TSHW	SCL "H" Pulse Width (Write)	TBD		ns	
	TSLW	SCL "L" Pulse Width (Write)	TBD		ns	
	TSCYCR	Serial Clock Cycle (Read)	TBD		ns	-Read Command & Data Ram
	TSHR	SCL "H" Pulse Width (Read)	TBD		ns	
	TSLR	SCL "L" Pulse Width (Read)	TBD		ns	
D/CX	TDCS	D/CX Setup Time	TBD		ns	
	TDCH	D/CX Hold Time	TBD		ns	
SDA (DIN) (DOUT)	TSDS	Data Setup Time	TBD		ns	For Maximum CL=30pF For Minimum CL=8pF
	TSDH	Data Hold Time	TBD		ns	
	TACC	Access Time	TBD	TBD	ns	
	TOH	Output Disable Time	TBD	TBD	ns	

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

7.2 Reset timing:



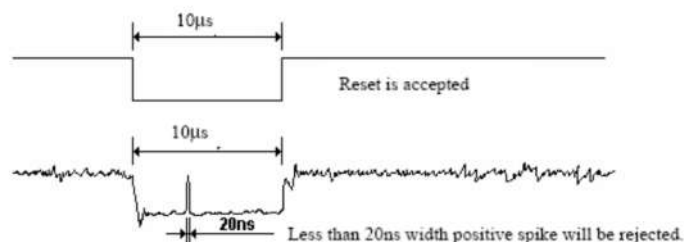
Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	tRESW	Reset Pulse Duration	10	-	us
	tREST	Reset Cancel	-	5	ms
				120	ms

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset Starts

3. 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 Hardware Reset.
4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

8. Inspection Standard

A. Sampling Method

Unless otherwise agreed upon in writing, the sampling inspection shall be applied to the Customer'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=0.65 Minor=1.5

B. Inspection Method

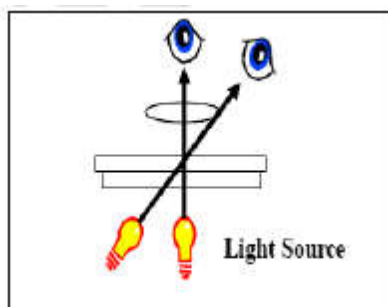
- 1) Ambient Condition:
 - a. Temperature: Room temperature $25\pm 5^{\circ}\text{C}$
 - b. Illumination: Single fluorescent lamp non-directive(300 to 700 Lux)

- 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 backlight, 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

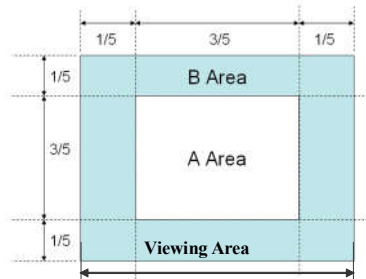


Figure 1

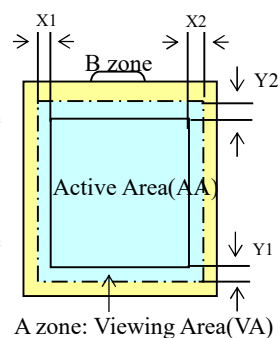
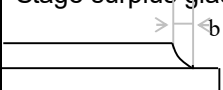
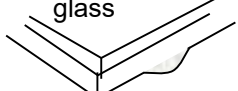
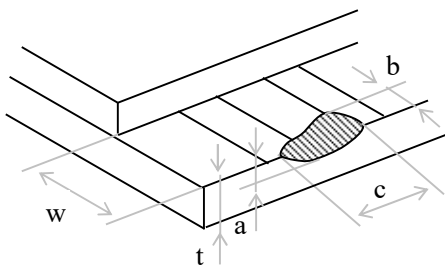
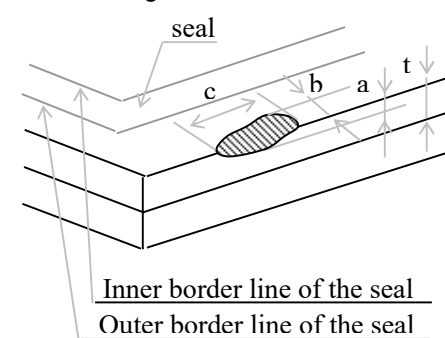
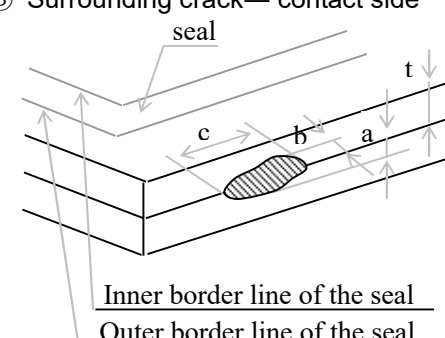
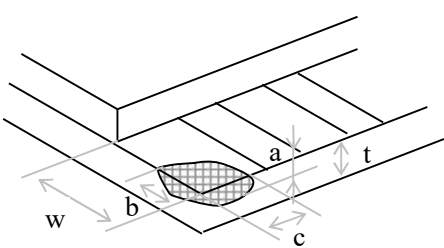


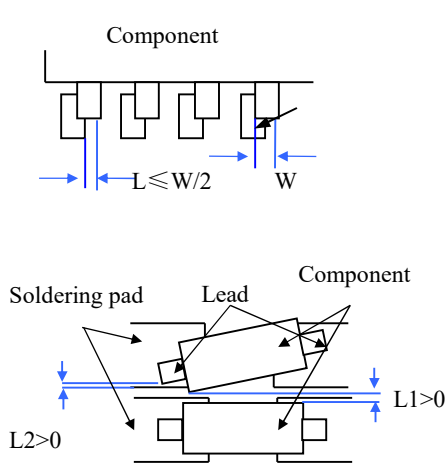
Figure 2

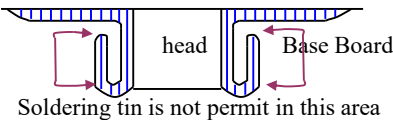
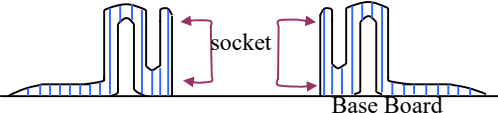
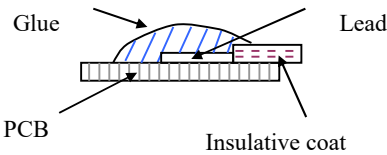
B. Cosmetic defect criteria

				Total	6	
		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	$\Phi \leq 0.3$	Neglected	Neglected
			B	$0.3 < \Phi \leq 0.7$	2	
			C	$0.7 < \Phi$	0	
7	Surplus glass	Stage surplus glass 	$b \leq 0.3\text{mm}$			
		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		Acceptable number
			Category(application: B zone)		
15	Glass defect crack	①The front of lead terminals	A	$a \leq t, \quad b \leq 1/5W, \quad c \leq 3\text{mm}$	Max.3 defects allowed
			B	Crack at two sides of lead terminals should not cover patterns and alignment mark	
		②Surrounding crack—non-contact side	$b < \text{Inner borderline of the seal}$		
					
③ Surrounding crack— contact side	$b < \text{Outer borderline of the seal}$				
					
		④Corner	A	$a \leq t, \quad b \leq 3.0, \quad c \leq 3.0$	

			B	Glass crack should not cover patterns u and alignment mark and patterns.	
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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	 head Base Board Soldering tin is not permit in this area  socket Base Board Soldering tin is not permit in this area
	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.	 Glue Lead PCB 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°C ~ 40°C

Relatively humidity: ≤80%

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

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