SPECIFICATION

FOR LCD MODULE

MODEL NO:	**TM12864S6CCWGWA**
CUSTOMER:	**OEM**
CUSTOMER P/N.	
VERSION	**V1.1**
CUSTOMER APPROVED	

□ Preliminary specification

■ Final specification

PREPARED BY	CHECKED BY	VERIFIED BY QA DEPT.	APPROVED BY
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REVISION RECORD

	Page	Revision Items	Name	Date
1.0		Final release	Lingkang_wu	2016-8-16
1.1	P10 P12	7.1 Modified Electrical characteristics 8.1 Add LED backlight characteristics	Lingkang_wu	2016-9-1

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1 General Specifications

Item	Contents
LCD type	FSTN
	Positive
LCD Duty	1/65
LCD Bias	1/9
Polarizer	Transflective
LCD background color	Gray
Segment color	blue-black
Backlighting	LED
Backlighting type	edge
Backlighting color	Blue
Backlighting drive	60mA
View direction	6:00
Operating temperature	-20℃~70℃
Storage temperature	-30℃~80℃
Controller	ST7567S
Frame	-
Technology	COG
Power supply	VDD=3.3V
Data Transfer	8-bit parallel

Notes:

- Color tone can slightly change with temperature and driving voltage.
- Color tone will be changed by backlight.

2 Absolute maximum ratings

(Without LED backlighting ,Ta=25℃)

Parameter	Symbol	Min	Max	Unit	Remark
Logic circuit supply voltage	V_{DD}	-0.3	+4.0	V	
LCD driving voltage	V_{LCD}	-0.3	+14	V	
Operating temperature range	Top	-20	+70	℃	No Condensation
Storage temperature range	Tst	-30	+80	℃	

Note :

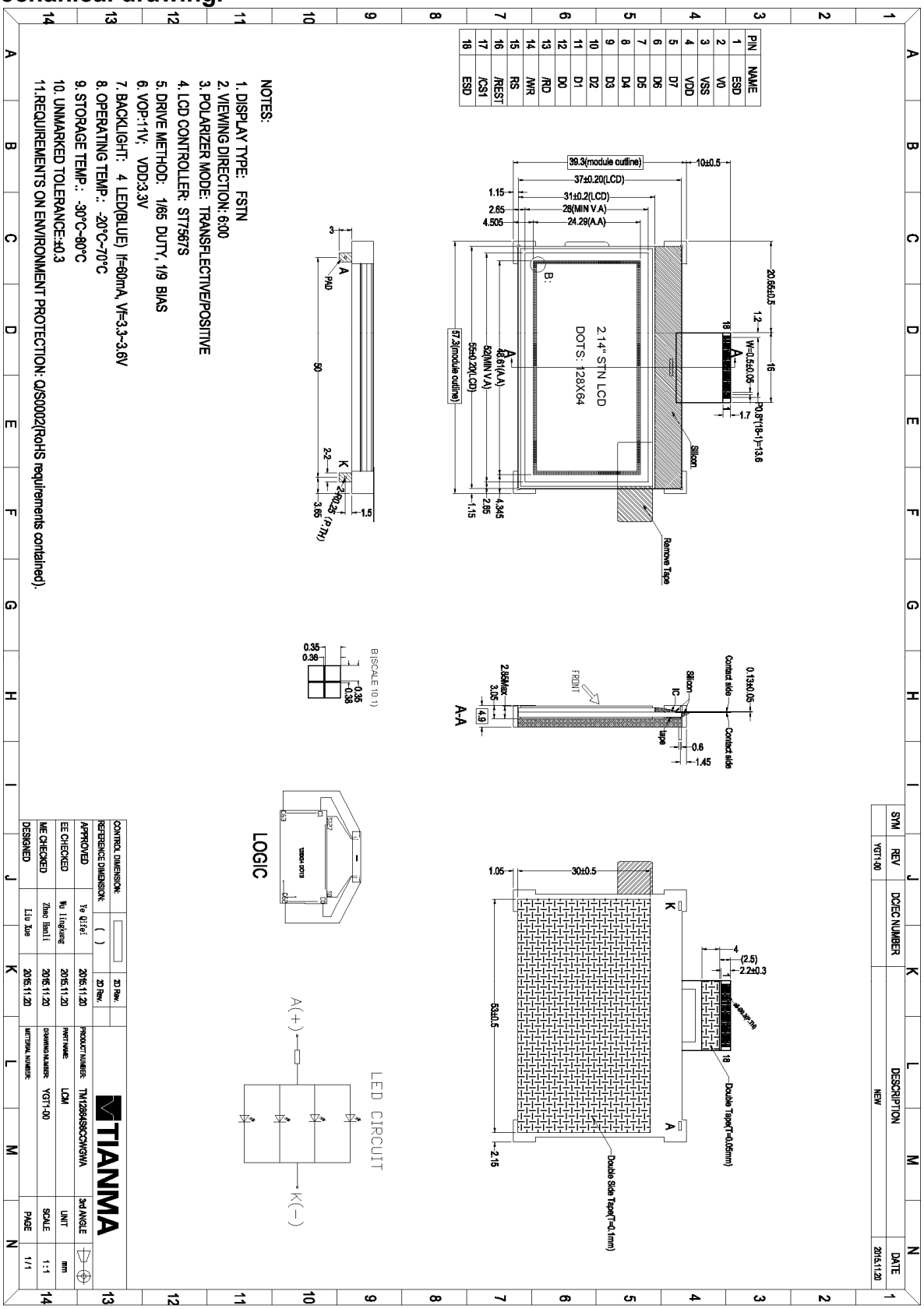
- LCD operating voltage $V_{LCD}=V_0 - XV_0$
- If the module is above these absolute maximum ratings. It may become permanently damaged.
- $V_{DD} \geq V_{SS}$ must be maintained.

3 Mechanical Characteristics

3.1 Mechanical features

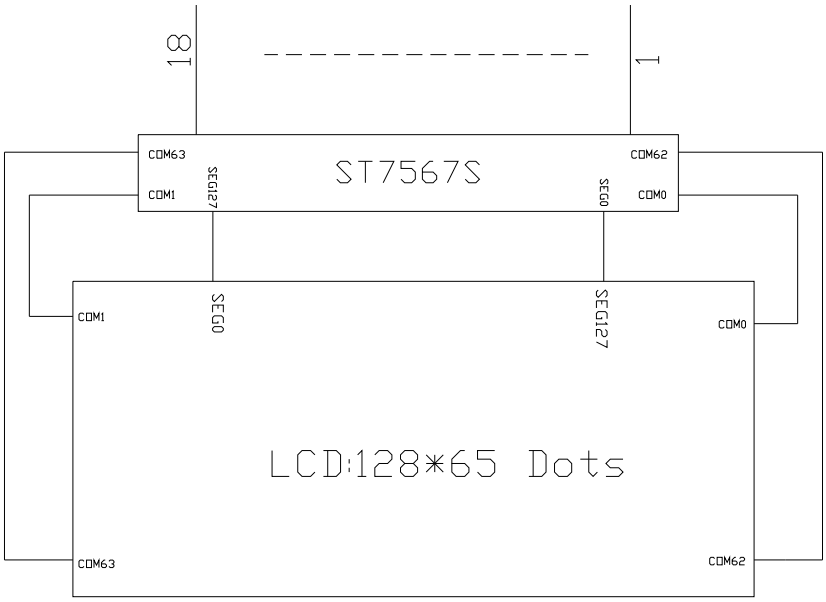
Parameter	Standard Value	Unit
Display type	Graphics module	--
Character size(W×H)	--	mm
Number of dots/characters (W×H)	128 x 64	--
View area (W×H)	52 x 28	mm
Active Area (W×H)	48.61x 24.29	mm
Dot Size (W×H)	0.35 x 0.35	mm
Dot Pitch (W×H)	0.38 x 0.38	mm
Module size(W×H×D)	57.3 x 39.3 x 4.9	mm
Module total weight (approx)	17	g
Module outline dimensions	Refer to page 5-“Mechanical drawing”	--

3.2 Mechanical drawing.

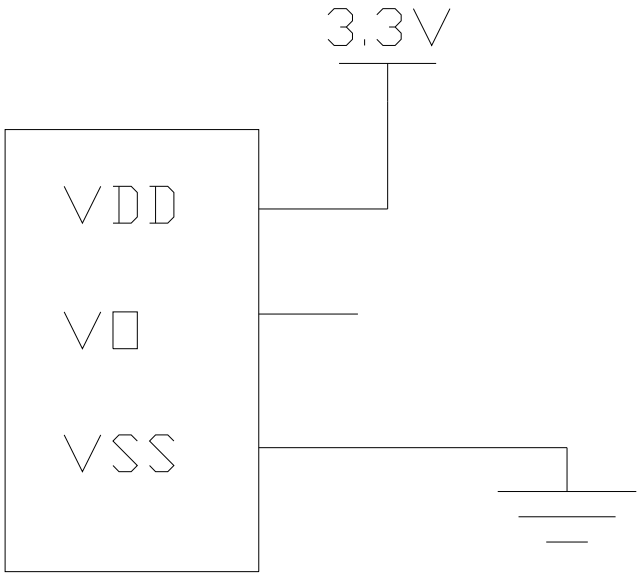


4 Circuit

4.1 Block Diagram



4.2 Recommend interface circuit



5 Interface description .

Pin No.	Symbol	I/O	Description
1	ESD	-	ESD PIN
2	V0	P	LCD driving voltage
3	VSS	P	Ground
4	VDD	P	Power supply
5~12	D7~D0	I	Data input
13	/RD	I	Read control
14	/WR	I	Write control
15	RS	I	Data/Command select
16	/REST	I	Reset pin
17	/CS1	I	Chip select
18	ESD	-	ESD PIN

6 Instruction Code & Timing characteristics

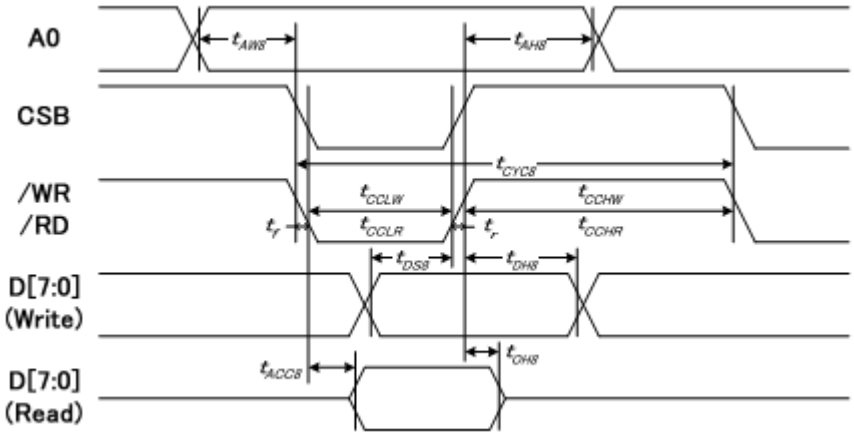
6.1 COMMAND

INSTRUCTION	A0	R/W (RWR)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
(1) Display ON/OFF	0	0	1	0	1	0	1	1	1	D	D=1, display ON D=0, display OFF
(2) Set Start Line	0	0	0	1	S5	S4	S3	S2	S1	S0	Set display start line
(3) Set Page Address	0	0	1	0	1	1	Y3	Y2	Y1	Y0	Set page address
(4)Set Column Address	0	0	0	0	0	1	X7	X6	X5	X4	Set column address (MSB)
	0	0	0	0	0	0	X3	X2	X1	X0	Set column address (LSB)
(5) Read Status	0	1	0	MX	D	RST	0	0	0	0	Read IC Status
(6) Write Data	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write display data to RAM
(7) Read Data	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read display data from RAM
(8) SEG Direction	0	0	1	0	1	0	0	0	0	MX	Set scan direction of SEG MX=1, reverse direction MX=0, normal direction
(9) Inverse Display	0	0	1	0	1	0	0	1	1	INV	INV =1, inverse display INV =0, normal display
(10) All Pixel ON	0	0	1	0	1	0	0	1	0	AP	AP=1, set all pixel ON AP=0, normal display
(11) Bias Select	0	0	1	0	1	0	0	0	1	BS	Select bias setting 0=1/9; 1=1/7 (at 1/65 duty)
(12) Read-modify-Write	0	0	1	1	1	0	0	0	0	0	Column address increment: Read:+0 , Write:+1
(13) END	0	0	1	1	1	0	1	1	1	0	Exit Read-modify-Write mode
(14) RESET	0	0	1	1	1	0	0	0	1	0	Software reset
(15) COM Direction	0	0	1	1	0	0	MY	-	-	-	Set output direction of COM MY=1, reverse direction MY=0, normal direction
(16) Power Control	0	0	0	0	1	0	1	VB	VR	VF	Control built-in power circuit ON/OFF
(17) Regulation Ratio	0	0	0	0	1	0	0	RR2	RR1	RR0	Select regulation resistor ratio
(18) Set EV	0	0	1	0	0	0	0	0	0	1	Double command!! Set electronic volume (EV) level
	0	0	0	0	EV5	EV4	EV3	EV2	EV1	EV0	
(19) Set Booster	0	0	1	1	1	1	1	0	0	0	Double command!!
	0	0	0	0	0	0	0	0	0	BL	Set booster level: BL=0: 4X BL=1: 5X
(20) Power Save	0	0	Compound Command								Display OFF + All Pixel ON
(21) NOP	0	0	1	1	1	0	0	0	1	1	No operation
(22)SPI Read Status	0	1	1	1	1	1	1	1	0	0	SPI read status command
	0	1	0	MX	D	RST	ID3	ID2	ID1	ID0	SPI read status
(23)SPI Read DDRAM	0	1	1	1	1	1	1	1	0	1	SPI read DDRAM command
	1	1	D7	D6	D5	D4	D3	D2	D1	D0	SPI read DDRAM

Note: Symbol "-" means this bit can be "H" or "L".

6.2 System Bus Timing for 8080 MCU Interface

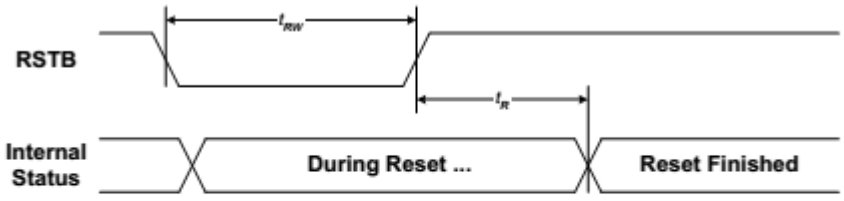
Note: Please refer to IC: ST7567S data sheet for more details.



(VDD1 = 3.3V , Ta =25°C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		10	—	
System cycle time	/WR	tCYC8		240	—	
/WR L pulse width (WRITE)		tCCLW		80	—	
/WR H pulse width (WRITE)		tCCHW		80	—	
/RD L pulse width (READ)	RD	tCCLR		140	—	
/RD H pulse width (READ)		tCCHR		80	—	
WRITE Data setup time	D[7:0]	tDS8		40	—	
WRITE Data hold time		tDH8		20	—	
READ access time		tACC8	CL = 16 pF	—	70	
READ Output disable time		tOH8	CL = 16 pF	5	50	

6.3 Reset Timing



(VDD1 = 3.3V , Ta =25°C)

Item	Symbol	Condition	Min.	Max.	Unit
Reset time	tR		—	1.0	us
Reset "L" pulse width	tRW		1.0	—	

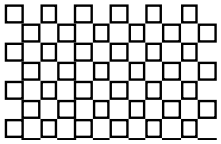
7 Electrical characteristics

7.1 Electrical characteristics

V_{SS}=0V, Ta=25℃

Parameter		Symbol	Condition	MIN	TYP	MAX	UNIT	Reference
Logic circuit supply voltage		V_{DD}	--	2.1	3.3	3.6	V	--
Input voltage for logic circuit	"H"level	V_{IH}	V_{DD}=3.3V	0.7VDD	--	VDD	V	--
	"L"level	V_{IL}		VSS	--	0.3VDD	V	--
Output voltage for logic circuit	"H"level	V_{OH}		0.8VDD	--	VDD	V	--
	"L"level	V_{OL}		VSS	--	0.2VDD	V	--
Logic power supply current (Without backlighting)		I_{DD}		--	--	2	mA	〔Note7-1〕
Operating voltage		Vop	V_{DD}=3.3V	10.7	11	11.3	V	〔Note7-2〕
Frame frequency		f	1/65Duty	-	75	-	Hz	〔Note7-3〕
Used driver IC		ST7567S of Sitronix						--

〔Note7-1〕The test pattern is small check. Refer to below pattern.



〔Note7-2〕The maximum and minimum ratings don't mean the LCD works well in the whole range of Vop. Vop must be adjusted to optimize the viewing angle and contrast. Refer to definition of drive voltage, refer to 7.2.

〔Note7-3〕The frequency shouldn't be too low to avoid flicker. Refer to definition of drive voltage, refer to 7.2.

7.2 Definition of drive voltage

(1) Definition of drive voltage and waveform

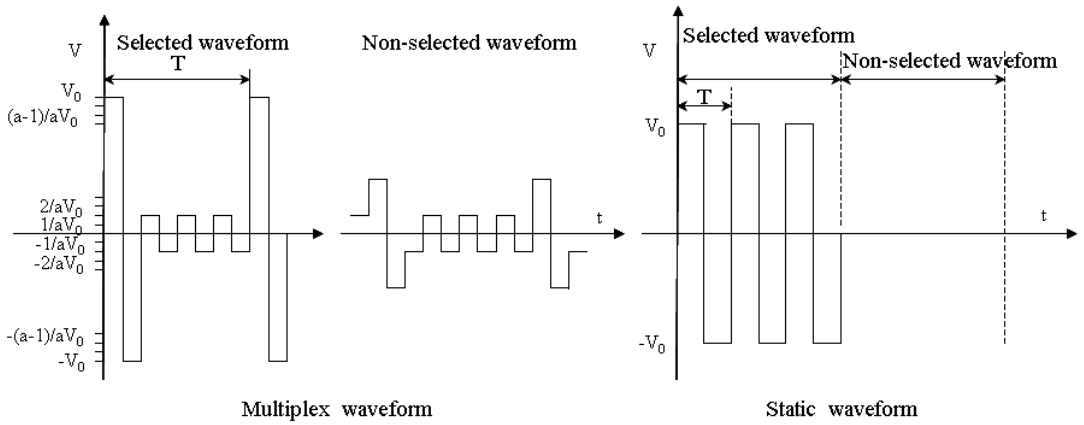


Fig.1 Definition of drive voltage and waveform

Operating voltage：Vop=V_0 Frame frequency: f=1/T

Duty: 1/N Bias: 1/a

(2) Operating voltage: Vop

TIANMA can evaluate whether the LCD can be redesigned to obtain customer preferable performance if customer's LCD drive voltage isn't adjustable.

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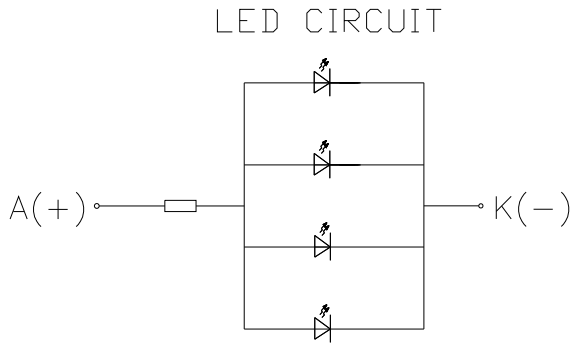
8 Optical Characteristics

8.1 LED backlight characteristics

Ta=25℃



Resistance：0~7.5Ω

Maximum Ratings:

Item	Symbol	Condition	MIN.	MAX.	Unit
Forward Current	IF	T=25℃	-	100	mA
Reverse Voltage	VR		-	5	V
Power Dissipation	PD		-	216	mW

Electrical/Optical characteristics:

Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Forward voltage	V_f	I_f=60mA	3.0	3.3	3.6	V
Average module brightness (without LCD)	Bp		300	450	600	cd/m^2
Uniformity	△Bp		70	--	--	%
Wavelength (without LCD)	λ		464	-	480	-- --
Color	Blue					

Note:

- Measured at the bare LED backlight unit.
- If the backlight is above these maximum ratings for long time, the service life of the LED backlight will reduce or it will cause poor reliability.

8.2 Optical Characteristics

Parameter	Symbol	Condition	Ratings			Unit	Reference
			Min.	Typ.	Max.		
Contrast ratio	Cr(θ=0°)	--	2	2.7	--	--	〔Note8-1〕
Viewing angle (Cr≥2)	Up(Φ=90°)	--	15	25	--	deg	〔Note8-2〕
	Down(Φ=270°)		28	38	--		
	Left (Φ=180°)		30	40	--		
	Right (Φ=0°)		10	20	--		
Response time	Tr + Tf	--	--	230	460	ms	〔Note8-3〕
Average module brightness (with LCD)	Bp	If=60mA	20	60	--	cd/m^2	〔Note8-4〕
Uniformity	△Bp		70	-	--	%	

〔Note8-1〕Refer to 8.2/8.3/8.4.

〔Note8-2〕Generally the viewing direction is 6:00 or 12:00, sometimes 3:00 or 9:00. The range of left to right and up to down based on Cr=2 show the viewing angle. Viewing angle range isn't the range of defects inspection. Refer to 8.3.

〔Note8-3〕The selected state is dark and non-selected state is white(or bright) with positive type, reversely the selected state is white (or bright) and non-selected state is dark with negative type. Refer to 8.5 definition of response time.

〔Note8-4〕The data are measured after LEDs are turned on for 5 minutes.

Measuring condition:

- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Drive condition: If=60mA.
- Measuring pattern: LCM display full white(positive).
- Measuring equipment: CS-2000 (Φ1mm) or similar equipment.
- Measuring spots: 9 measured spots.
- Measuring distances: 50cm.

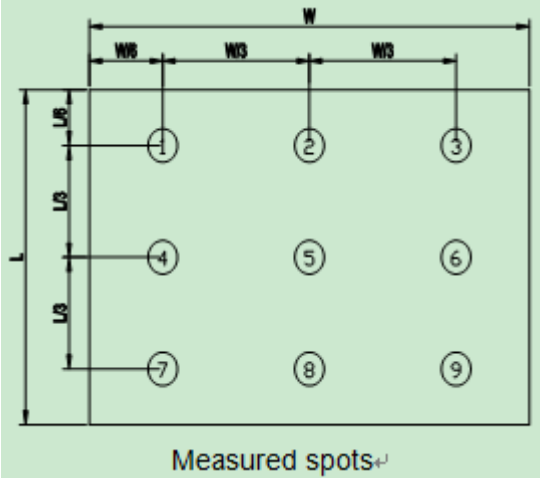
The brightness and color coordinate are the average value of 9 measured spots.

The luminance uniformity is calculated by using following formula:

△Bp = Bp (Min.) / Bp (Max.)×100 (%)

Bp (Max.) = Maximum brightness in 9 measured spots

Bp (Min.) = Minimum brightness in 9 measured spots.



Measured spots

*Color coordinates measurement error allowance is ±0.01;

*Average module brightness measurement error allowance is 3%;

8.3 Optical characteristics measurement equipment and method

The setup and test method are showed in fig.2. Test methods are different according to different illumination mode.

Transmissive mode: light resource is placed at the back of LCD.

Reflective mode and transflective mode: light resource is placed at the front side of LCD.

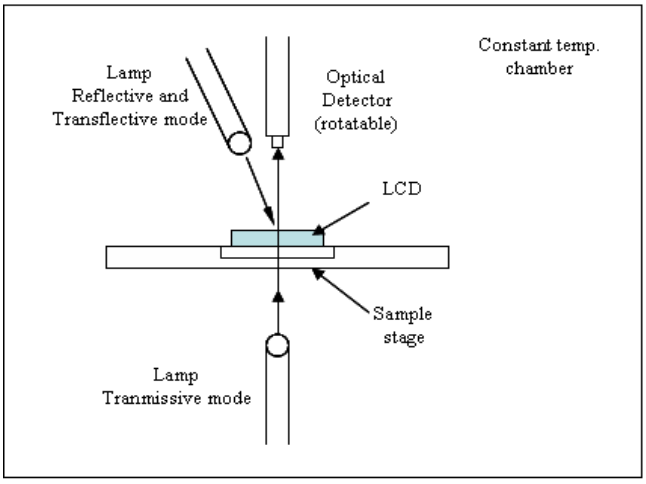


Fig.2 Optical characteristics measurement equipment

The chamber temperature, light resource and driving signal should be stable before testing. If test the characteristics under high or low temperature, the test system should be stable for more than 10 minutes before testing.

8.4 Definition of viewing direction

Refer to the graph below marked by *θ* and *Φ*

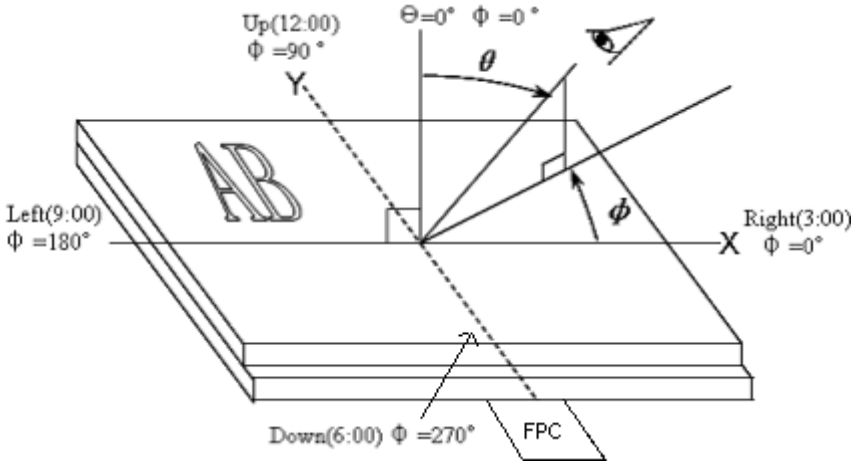


Fig.3 Definition of viewing direction

8.5 Definition of contrast ratio

Contrast ratio can be calculated by the formula (9-1) below for positive type. If the LCD is positive type, Cr (*θ, Φ*) is equal to luminance (*θ, Φ,* selected state*)* divided by luminance (*θ, Φ, non*-selected state). Fig.4 shows the relationship between selected state, non-selected state and bright state, dark state.

$$\mathrm{Cr}(\theta,\phi)=\frac{L_2}{L_1}=\frac{\mathrm{Luminance}(\theta,\phi)\ (\mathrm{Dark\ state})}{\mathrm{Luminance}(\theta,\phi)\ (\mathrm{Bright\ state})} \qquad (9\text{-}1)$$

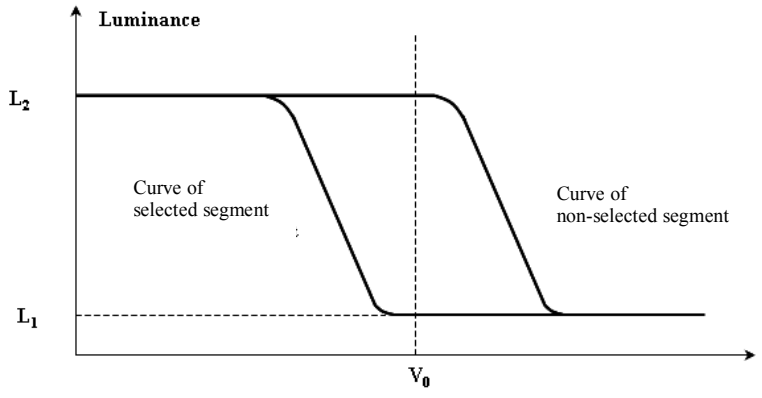


Fig.4 Electro-optical characteristic (EOC) graph (positive type)

8.6 Definition of response time

Turn on time (rise time): $t_{on} = t_d + t_r$ (from non-selected state to selected state)

Turn off time (fall time): $t_{off} = t_D + t_R$ (from selected state to non-selected state)

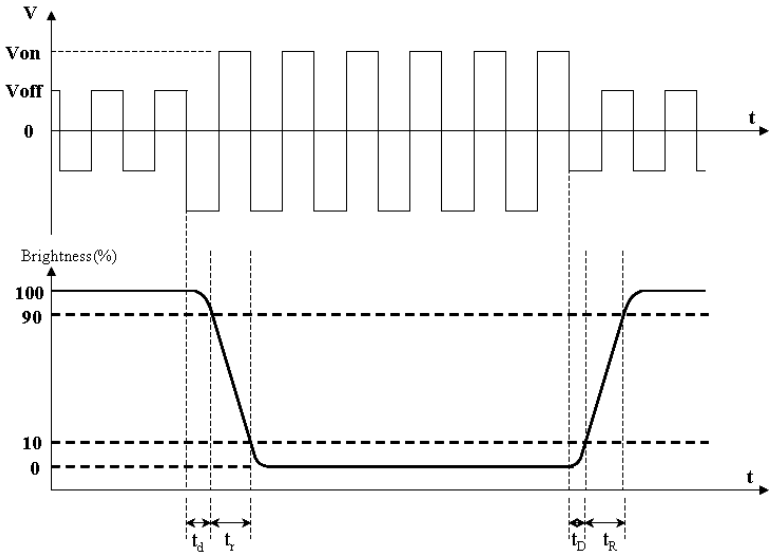


Fig.5 Definition of response time (positive type)

8.7 Definition of viewing angle

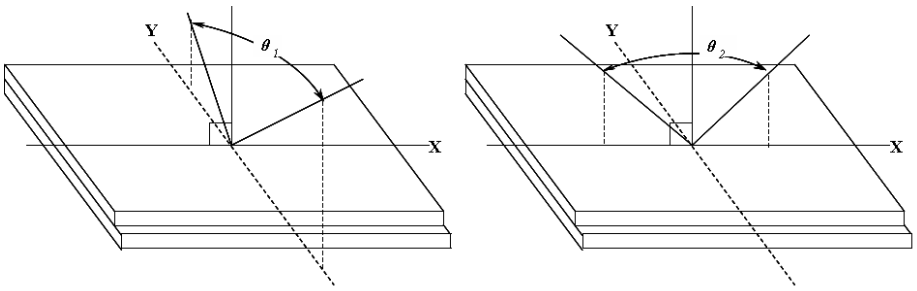


Fig 6 Definition of viewing angle

θ_1 ——range of viewing angle from up to down

θ_2 ——range of viewing angle from left to right.

9 Reliability

9.1 Environmental / Reliability Test

No	Test Item	Test condition	Criterion
1	High Temperature Storage	80℃±2℃ 240H Restore 2H at 25℃ Power off	IEC60068-2-1:2007 GB2423.2-2008
2	Low Temperature Storage	-30℃±2℃ 240H Restore 2H at 25℃ Power off	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Operation	70℃±2℃ 240H Restore 2H at 25℃ Power on	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Operation	-20℃±2℃ 240H Restore 4H at 25℃ Power on	IEC60068-2-1:2007 GB2423.1-2008
5	High Temperature & Humidity Storage	40℃±2℃ 90%RH 240H Power off	IEC60068-2-78 :2001 GB/T2423.3—2006
6	Temperature Cycle	−30℃←→25℃←→80℃ 30min 5min 30min after 10cycle, Restore 2H at 25℃ Power off	Start with cold temperature, End with high temperature, IEC60068-2-14:1984, GB2423.22-2002
7	Vibration Test	10Hz~150Hz, 50m/s^2, 40min	IEC60068-2-6:1982 GB/T2423.10—1995 After testing, cosmetic and electrical defects should not happen.
8	Shock Test	Half-sine wave,300m/s^2,11ms ± X,± Y,± Z 3times, for each direction	IEC60068-2-27:1987 GB/T2423.5—1995
9	Drop Test(package state)	800mm, concrete floor,1corner, 3edges, 6 sides each time	1.After testing, cosmetic and electrical defects should not happen. 2.the product should remain at initial place 3.Product uncovered or package broken is not permitted.
10	ESD Test	150pF，330Ω air discharge ±8KV 5times contact discharge ±4KV 5times	LCD module should not be damaged after test. can refresh after reset.

Notes:

1. Each test item applies for a test sample only once, The test sample can't be used again in any other test .
2. The test sample is inspected after 2 hours or more storing at room temperature and room humidity after each test item is finished.
3. For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.
4. LCD Lifetime: min. 50% of the initial contrast ratio after 50,000 hours min. of operation @ 25°C operating temperature and 3.3V VDD power supply.
5. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after reseting, it would be judge as a good part. Using ionizer (an antistatic blower) is recommended at working area in order to reduce electro-static voltage. When removing protection film from LCM panel, peel off the tag slowly(recommended more than three seconds) while blowing with ionizer toward the peeling face to minimize ESD which may damage electrical circuit.
6. Polarizer test criteria
   a. when testing avoid samples take out then return, It can cause water coagulation in Polarizer. Increase the distance of samples , And put samples before the wind.
   b. When the samples are put into the test, put them upright so that the glasses keep spaces between them each other. (Fig.7)

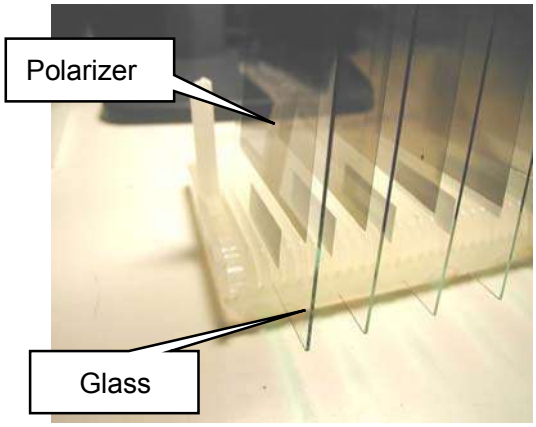


Fig.7

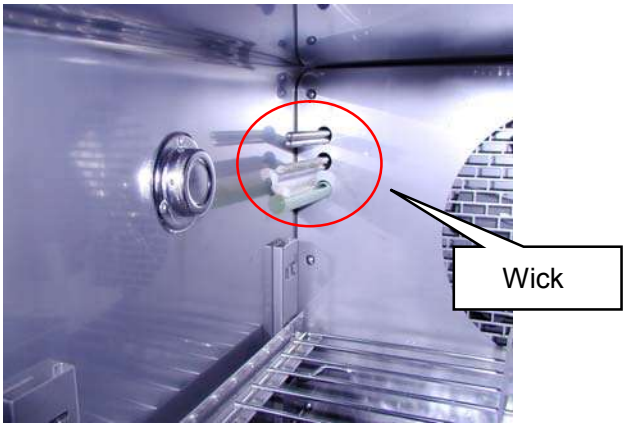


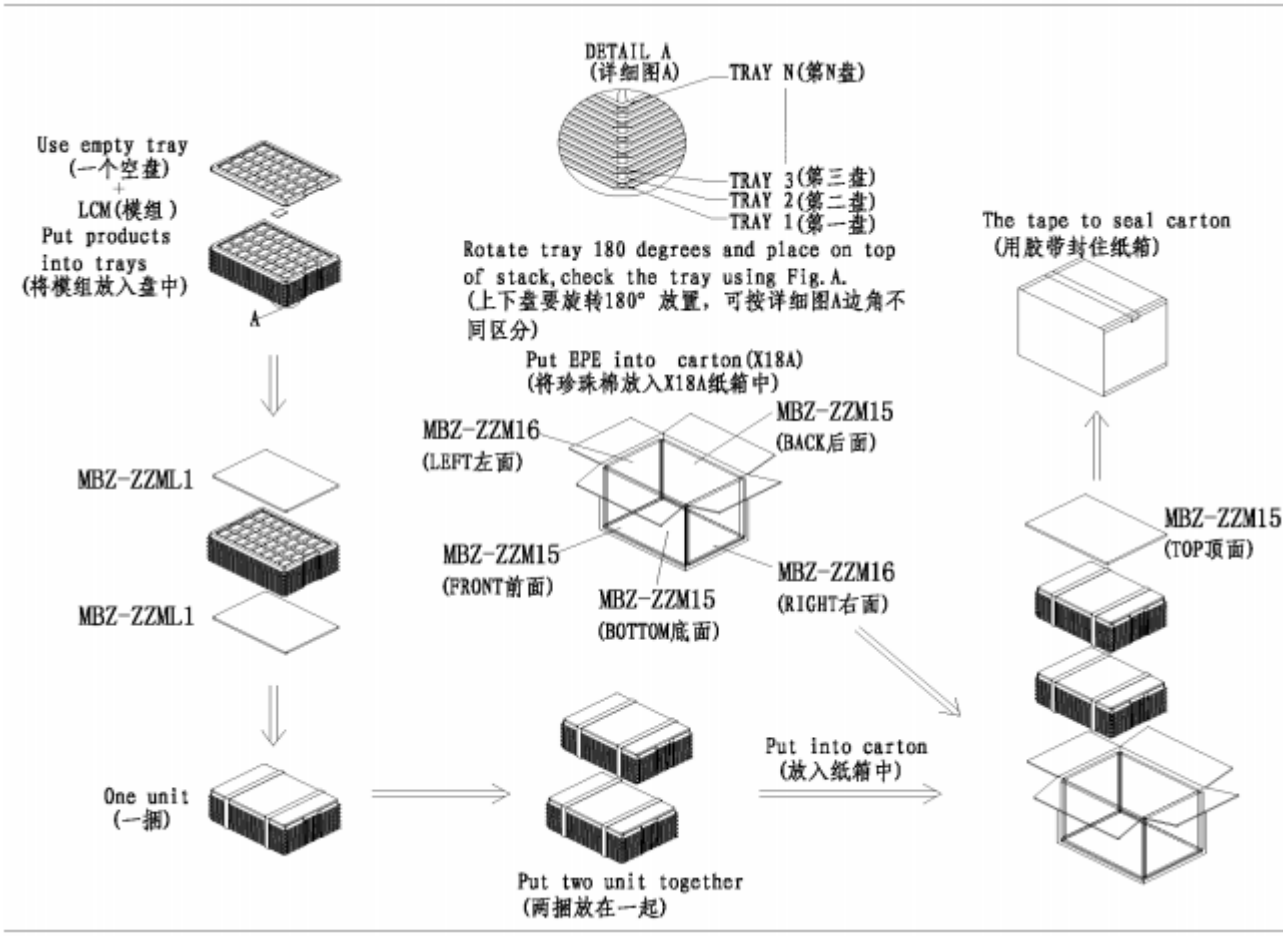
Fig.8

   c. Put samples into testing machine as small as possible so that it is drafty.
   d. Do not put samples under wick because water will fall.(Fig.8)
   e. Do not open testing machine except for taking them out in order to prevent moisture condensation.
7. The criteria refer to 9.2.

9.2 Inspection of criteria

Remark NO.	Content
1	Functional test is OK. Missing Segment, shorts, unclear segment, non-display, display abnormally, liquid crystal leak are unallowable.
2	After testing, cosmetic defects should not happen, no low temperature bubbles, seal loose and fall, frame rainbow, ACF bubble growing are unallowable in the appearance test.
3	Total current consumption should not be over 150% of initial value.
4	After tests being executed, Contrast must be larger than 70% of its initial value prior to the tests.
5	No glass crack, chipped glass, end seal loose frame crack and so on.
6	No structure loose and fall.

10 Package



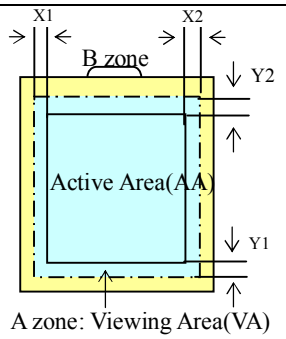
11 Quality level

11.1 Classification of defects

Major defects (MA): A major defect refers to a defect that may substantially degrade usability for product applications, including all functional defects (such as no display, abnormal display, open or missing segment, short circuit, missing component), outline dimension beyond the drawing, progressive defects and those affecting reliability.

Minor defects (MI): A minor defect refers to a defect which is not considered to be able to substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation, such as black spot, white spot, bright spot, pinhole, black line, white line, contrast variation, glass defect, polarizer defect, etc.

11.2 Definition of inspection range

For LCD defects, dividing two areas to make a judgment (according figure 1). A zone : Inside Viewing area B zone : Outside Viewing area X1(A.A~V.A): 1.695mm X2(A.A~V.A): 1.695mm Y1(A.A~V.A): 1.855mm Y2(A.A~V.A): 1.855mm	 Figure 1

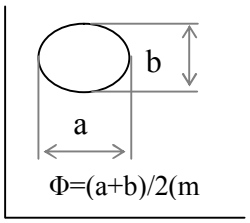
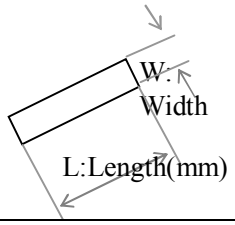
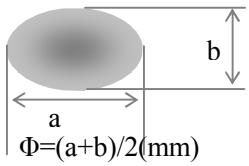
11.3 Inspection items and general notes

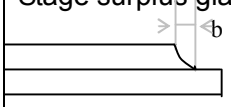
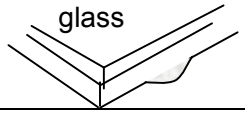
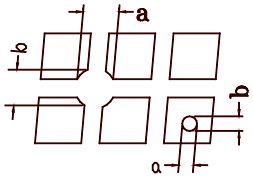
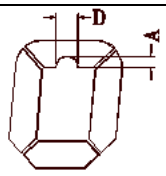
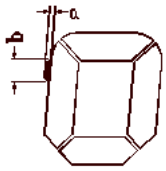
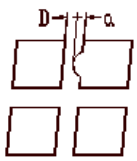
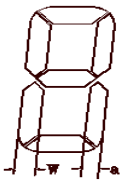
General notes	①Should any defects which are not specified in this standard happen, additional standard shall be determined by mutual agreement between customer and TIANMA. ②Viewing area should be the area which TIANMA guarantees. ③Limit sample should be prior to this Inspection standard. ④Viewing judgment should be under static pattern. ⑤Inspection conditions Inspection distance: 350 mm (from the sample) Temperature : 25±5 ºC Inspection angle : 45 degrees in 6o′clock direction (all defects in viewing area should be inspected from this direction)	
Inspection items	Pinhole, Bright spot, Black spot, White spot, Black line, White Line, Foreign particle, Bubble	The color of a small area is different from the remainder. The phenomenon doesn't change with voltage
	Contrast variation	The color of a small area is different from the remainder. The phenomenon changes with voltage
	Polarizer defect	Scratch, Dirt, Particle, Bubble on polarizer or between polarizer and glass
	Functional defect	no display, display abnormally, open or missing segment, short circuit, False viewing direction
	Glass defect	Glass crack, Shaved corner of glass, Surplus glass
	Segment defect	Pin holes or cracks in segment, Transformation of segment
	PCB defect	Components assembly defect

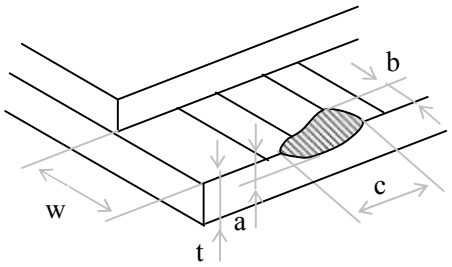
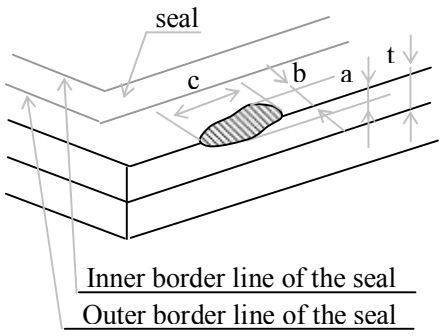
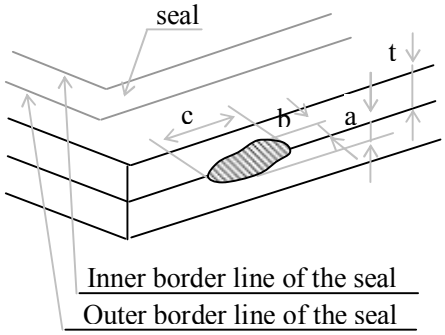
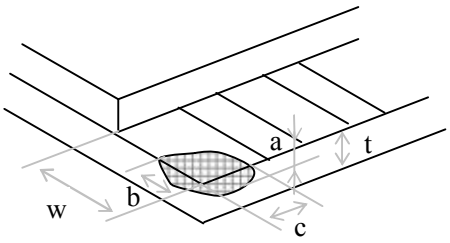
11.4 Outgoing Inspection level

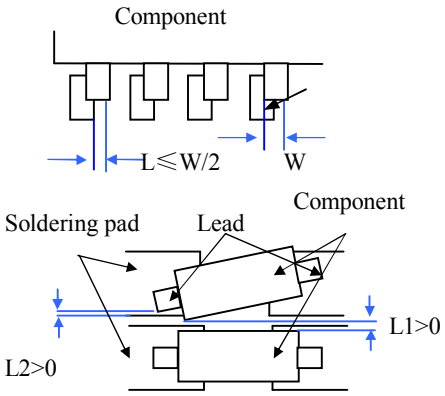
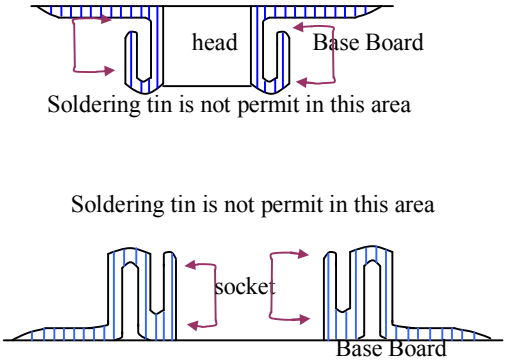
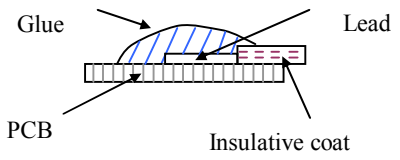
Outgoing Inspection standard	Inspection conditions	Inspection				
		Min.	Max.	Unit	IL	AQL
Major Defects	See 12.3 general notes	See 12.5			II	0.65
Minor Defects	See 12.3 general notes	See 12.5			**II**	1.5
Note：Sampling standard conforms to GB2828						

11.5 Inspection Items and Criteria

Inspection items			Judgment standard			
			Category		Acceptable number	
					A zone	B zone
1	Black spot,White spot, Bright Spot, Pinhole, Foreign Particle, Particle in or on glass, Scratch on glass		A	Φ≦0.10	Neglected	Neglected
			B	0.10<Φ≦0.20	3	
			C	0.20<Φ	0	
2	Black line, White line, Particle Between Polarizer and glass, Scratch on glass		A	W≦0.02	Neglected	Neglected
			B	0.02<W≦0.05 L≦3.0	3	
			C	W＞0.05 or L＞3.0	0	
3	Contrast variation		A	Φ≦0.2	Neglected	Neglected
			B	0.2<Φ≦0.3	2	
			C	0.3<Φ≦0.4	1	
			D	0.4<Φ	0	
			Total defective point(B,C)		3	
4	Bubble inside cell		any size		none	none
5	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	

6	Surplus glass	Stage surplus glass 	b≦0.3mm		
		Surrounding surplus glass 	Should not influence outline dimension and assembling.		
7	Open segment or open common		Not permitted		
8	Short circuit		Not permitted		
9	False viewing direction		Not permitted		
10	Contrast ratio uneven		According to the limit specimen		
11	Crosstalk		According to the limit specimen		
12	Black /White spot(display)		Refer to item 1		
13	Black /White line(display)		Refer to item 2		
14	Pin holes and cracks in segment		not counted	Max.3 dots allowed	Max.3 dots allowed
			x<0.1mm	0.1mm≤x≤0.2mm	
			x=(a+b)/2		
			not counted	Max.2 dots allowed each segment	
			A<0.1mm	0.1mm≤A≤0.2mm D<0.25mm	
15	Transformation of segment		not counted	Max.1 defect allowed each segment	Max.3 defects allowed
			x<0.1mm	0.1mm≤x≤0.2mm	
			x=(a+b)/2		
			not counted	Max.1 defect allowed each segment	
			a<0.1mm	0.1mm≤a≤0.2mm D>0	
			0.8W≤a≤1.2W a=measured value of width W=nominal value of width		Max.2 defects allowed

Inspection items			Judgment standard		
			Category(application: B zone)		Acceptable number
16	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)
17	PCB defect	Component soldering: No cold soldering、short、open circuit、burr、tin ball The flat encapsulation component position deviation must be less than 1/2 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.	

12 Precautions for Use of LCD Modules

12.1 Handling Precautions

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

12.1.2 Liquid in LCD is hazardous substance, 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, thoroughly and promptly wash it off using soap and water.

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

12.1.4 Don't touch, push or rub the exposed polarizer covering the display surface of the LCD module with anything harder than an HB pencil lead, the polarizer is soft and easily scratched, handle it carefully.

12.1.5 Don't put or attach anything on the display area to avoid leaving any marks on.

12.1.6 If the display surface is contaminated or becomes dusty, breathe on the surface and gently wipe it with a soft dry cloth. do not scrub hard to avoid damage the surface. 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

12.1.7 Do not attempt to disassemble the LCD Module.

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

12.1.9 Avoid using the same display pattern long time (continous ON segment).Software must be prepared so that the pattern will be changed

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

a. Be sure to ground the body and electric appliances when handling the LCD Modules. It is preferable to use conductive mat on table and wear cotton clothes or conductive processed fibre. Synthetic fibre is not recommended.

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 careful and slow when peeling off this protective film since static electricity may be generated. It is recommended to use ionic fan or machine when operating. It is recommended to remove the protection foil slowly (> 3 sec.).

e. It is preferable to wear gloves etc, to avoid damaging the LCD. Please do not touch electrodes with bare hands or avoid any other contamination.

12.2 Storage precautions

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

12.2.2 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 : 5℃ ～ 40℃

Relatively humidity: ≤80%

12.2.3 The LCD modules should be stored in a clean environment or room, free from acid, alkali and harmful gas.

12.2.4 Store the module in anti-static electricity container and without any physical load.

12.3 Transportation precautions

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

12.4 Soldering

12.4.1 Use the high quality solders, only solder the I/O terminals.

12.4.2 No higher than 280℃ and time less than 3-4 second during soldering.

12.4.3 Rewiring: no more than 3 times.

12.4.4 when you remove connector or cable soldered to I/O terminals, please confirm that solder is fully melted. If you remove by force, electrodes at I/O terminals may be damaged (or stripped off). It is recommended to use solder suction machine.