TIANMA
Microelectronics Co.,LTD

SPECIFICATION FOR TFT LCD MODULE

MODEL NO:	**TM024HDZ73**
CUSTOMER:	
CUSTOMER P/N.	
VERSION	**V1.0**
CUSTOMER APPROVED	

□ **Preliminary Specification**

■ **Final Specification**

PREPARED	CHECKED	VERIFIED BY QA DEPT	VERIFIED BY R&D DEPT

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REVISION RECORD

Date	Rev.No.	Page	Revision Items	Prepared
2011.4.20	**V0.0**	**1**	**Preliminary Specification**	YL
2011.5.23	**V1.0**	**1**	**The first release**	YL

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1. General Specifications

TM024HDZ73 is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver IC, FPC and a back light unit. The 2.4″ display area contains 240 x 320 pixels and can display up to 262K colors. This product accords with RoHS environmental criterion.

Item	Contents	Unit	Note
LCD Type	a-si TFT	-	
Display Color	65K/262K		1
LCD Duty	1/320	-	
Viewing Direction	12:00	O'Clock	
Active Area(W×H)	36.72×48.96	mm	
Number of Dots	240(RGB)×320	mm	
Dot Pitch(W×H)	0.153X0.153	mm	
Controller	ILI9340	-	
VCC	2.8	V	
IOVCC	1.8/2.8	V	
Outline Dimensions	Refer to outline drawing on next page		
Backlight	4-LEDs(white parallel)	-	
Weight	TBD	g	
Interface	CPU 8/16 bits	-	
Polarizer Mode	Transmissive/Positive	-	

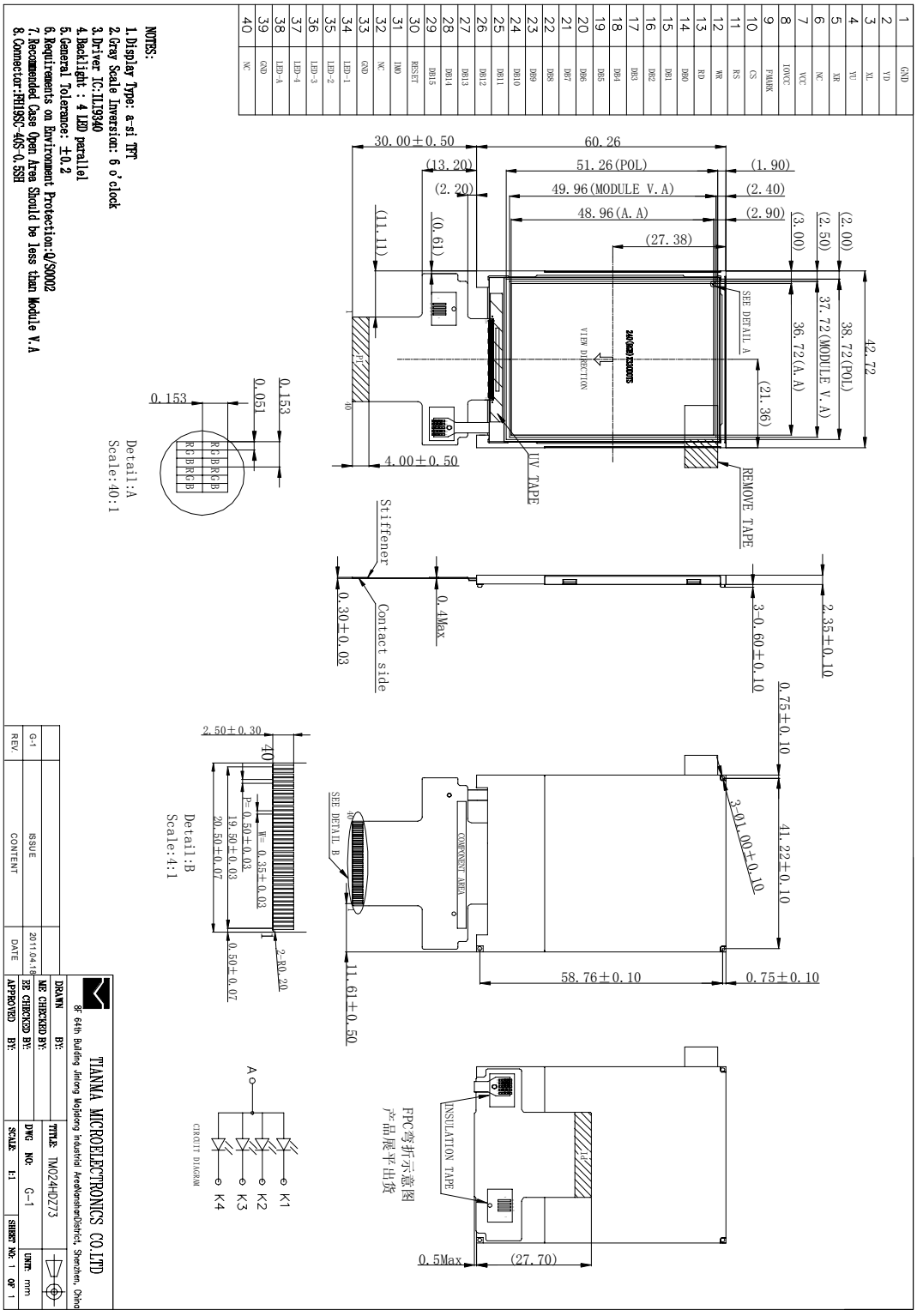
Note 1: Color tune is slightly changed by temperature and driving voltage.

Note 2: Requirements on Environmental Protection:RoHS

Note 3: Customer should do assembly according to our FPC bending sketch in the outline drawing.

Note 4: Please approve our spec before placing mass production order. Otherwise we will regard customer has approved the spec when we receive the first 2Kpcs or above order from customer.

2. Outline Drawing



NOTE 1: FPC,BL,TP etc. may have not only one provider, appearance, silk-screen may exist difference.

NOTE 2:Customer's rind(handset rind etc.) and TIANMA's standard module may exist interference , Customer should advise on TIANM FAE or RD change rind.

3. Absolute Maximum Ratings(Ta=25℃)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VCC	-0.3	4.6	V	1，2
Logic Signal Input /Output Voltage	IOVCC	-0.3	4.6	V	
Operating Temperature	Top	-20	+70	℃	
Storage Temperature	Tst	-30	+80	℃	

Notes:

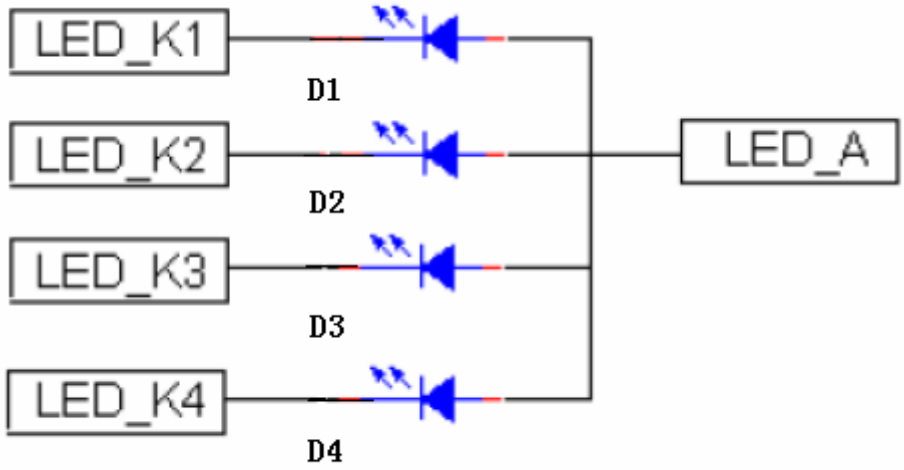
1. If the module is above these absolute maximum ratings. It may become permanently damaged. Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.
2. V_{DD} >V_{SS} must be maintained.

4. Electrical Specifications and Instruction Code

4.1 Electrical characteristics(Vss=0V ,Ta=25℃)

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Logic Supply Voltage		IOVCC	1.65	1.8/2.8	3.3	V	
Analog Supply Voltage		VCC	2.3	2.8	3.3	V	
Input Signal Voltage	Low Level	V_{IL}	0.8x IOVCC	-	IOVCC	V	DB0-DB15,IM0,RD,RS, CS,WR,RESET
	High Level	V_{IH}	-	-	0.2xIOVCC	V	
Output Signal Voltage	Low Level	V_{OL}	0.8xIOVCC	-	-	V	
	High Level	V_{OH}	-	--	0.2xIOVCC	V	

4.2 LED backlight specification(Vss=0V ,Ta=25℃)



Item	Symbol	Min	Typ	Max	Unit	Condition	Note
Forward Voltage	V_F	2.8	3.2	3.5	V	If=80mA	
Luminance Center	L_C	5100	5700	-	Cd/m^2	1. If=20mA/LED 2. Aper ture:9 point 3. instrument is :BM-7A 4. Uniformity=min/max*100%	
Uniformity	△Bp	80	-	-	%		
Color Coordinate	X	0.260	0.285	0.310			
	Y	0.260	0.285	0.310			

4.3 Interface Signals

No	Symbol	I/O	Description	Comment
1	GND	P	Power Ground	
2	YD	O	Floating	
3	XL	O	Floating	
4	YU	O	Floating	
5	XR	O	Floating	
6	LCD_ID	-	Floating.	
7	VCC	P	Power Supply of Analog	
8	IOVCC	P	Power Supply of Logic	
9	FMARK	O	Tearing effect output pin to synchronize MPU to frame writing	
10	CS	I	Chip select signal	
11	RS	I	Register select signal	
12	WR	I	Write enables signal	
13	RD	I	Read enables signal	
14	DB0	I/O	Data Input	
15	DB1	I/O	Data Input	
16	DB2	I/O	Data Input	
17	DB3	I/O	Data Input	
18	DB4	I/O	Data Input	
19	DB5	I/O	Data Input	
20	DB6	I/O	Data Input	
21	DB7	I/O	Data Input	
22	DB8	I/O	Data Input	
23	DB9	I/O	Data input	
24	DB10	I/O	Data input	
25	DB11	I/O	Data input	
26	DB12	I/O	Data input	
27	DB13	I/O	Data input	
28	DB14	I/O	Data input	
29	DB15	I/O	Data input	
30	RESET	I	Reset signal	
31	IM0	I	Mode select signal	Note2
32	NC	-	Floating	
33	GND	P	Power Ground	
34	LED_K1	P	LED light cathode	
35	LED_K2	P	LED light cathode	
36	LED_K3	P	LED light cathode	
37	LED_K4	P	LED light cathode	
38	LED_A	P	LED light anode	
39	GND	P	Power Ground	
40	NC	-	Floating	

Note1: I/O definition：I-----Input O---Output P----Power/ Ground NC--- Not Connected

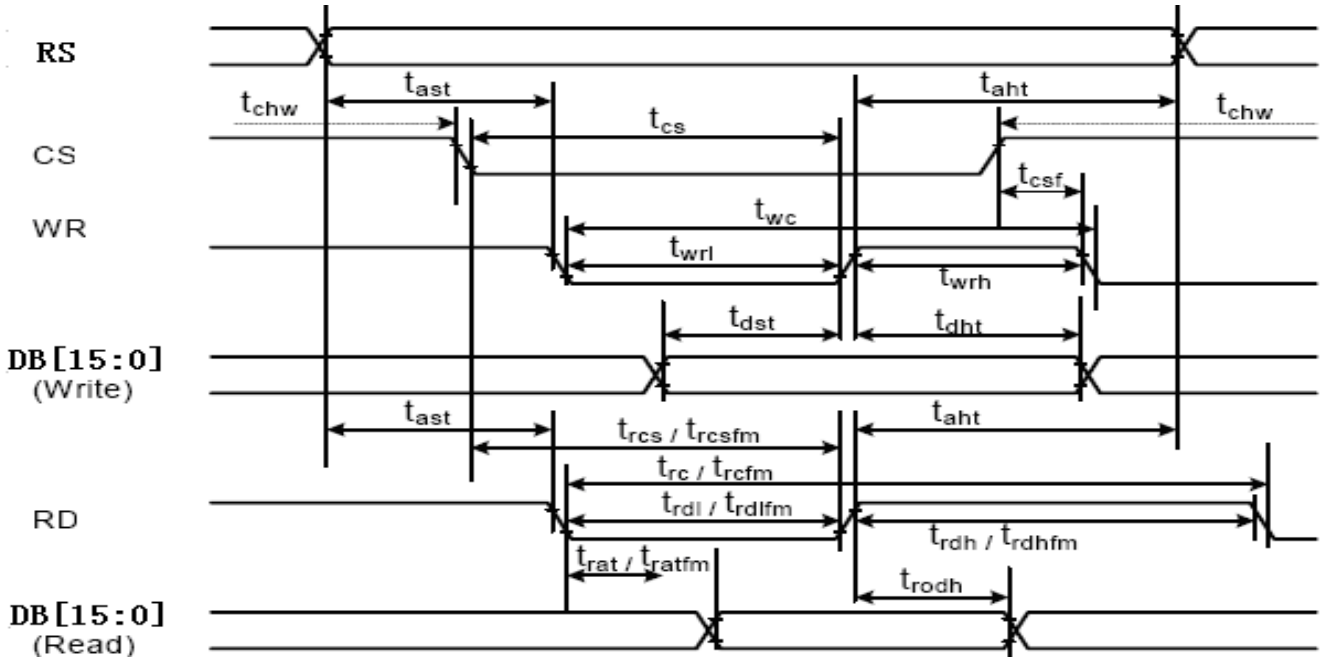
Note2:

IM0	Interface	Data Bus Use	
		Register/Content	GRAM
1	8080 MCU 8_Bit Parallel	DB15~DB8	DB15~DB8
0	8080 MCU 16_Bit Parallel	DB7~DB0	DB15~DB0

4.4 Interface Timing Chart

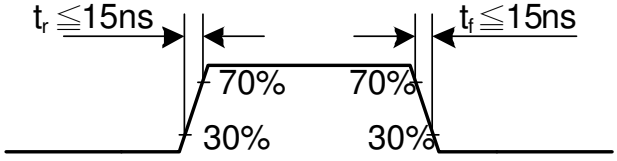
ILITEK's ILI9340 interface protocal Inter 80 system CPU interface

Note: Please refer to ILITEK's ILI9340 data sheet for more details.



Signal	Symbol	Parameter	min	max	Unit	Description
RS	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	10	-	ns	
CS	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WR	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	33	-	ns	
	twrl	Write Control pulse L duration	33	-	ns	
RD (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RD(ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
DB[15: 0] ,	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	60	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Note: Ta = -30 to 70 ℃, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, VSS=0V.



5. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		θ=0° Φ=0°	280	310	-	Cd/m^2	1
Uniformity	△Bp			-	80%	-		1,2
Viewing Angle	θ1 (Φ=90°)		Cr≥10	50	60	-	Deg	3
	θ1 (Φ=270°)			60	70	-		
	θ2 (Φ=0°)			60	70	-		
	θ2 (Φ180°)			60	70	-		
Contrast Ratio	Cr		θ=0°	400	500	-	-	4
Response Time	T_r		25℃	-	20	30	ms	5
	T_f							
Color of CIE Coordinate	W	x	θ=0° Φ=0°	0.240	0.290	0.340	-	1,6
		y		0.270	0.320	0.370	-	
	R	x		0.542	0.592	0.642	-	
		y		0.294	0.344	0.394	-	
	G	x		0.285	0.332	0.385	-	
		y		0.531	0.581	0.631	-	
	B	x		0.099	0.149	0.199	-	
		y		0.054	0.104	0.154	-	
NTSC Ratio	S			-	53%	-		

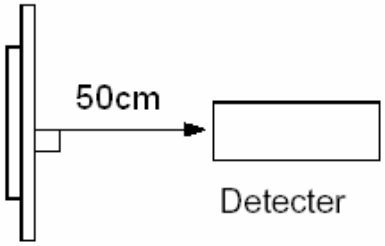
Note：The parameter is slightly changed by temperature, driving voltage and materiel.

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ8mm)

Measuring condition:

- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

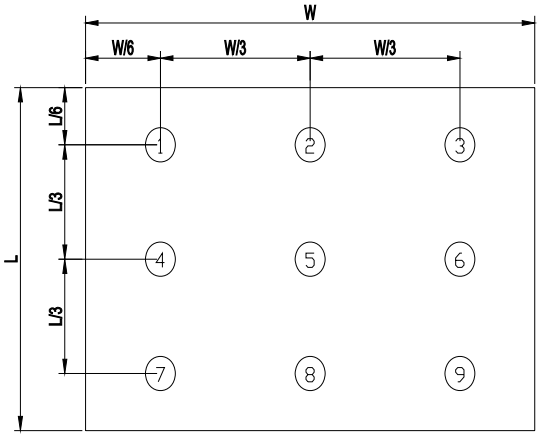


Note 2: The luminance uniformity is calculated by using following formula.

△Bp = Bp (Min.) / Bp (Max.)×100 (%)

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

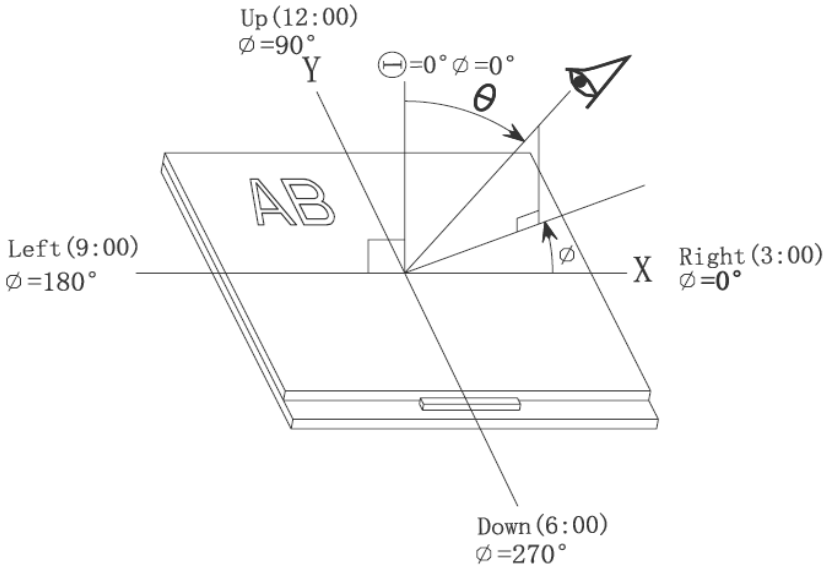
Bp (Min.) = Minimum brightness in 9 measured spots.



Measurement equipment PR-705 (Φ8mm)

Note 3: The definition of viewing angle:

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



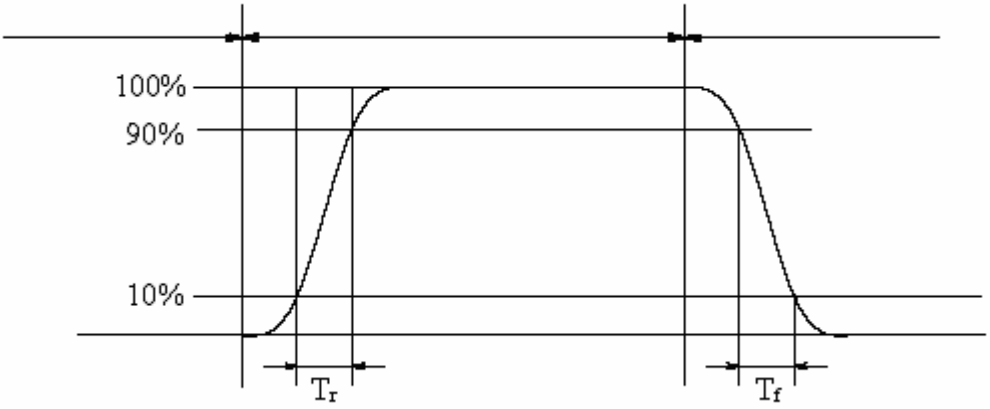
Note 4: The definition of contrast ratio (Test LCM using PR-705):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at “White” state}}{\text{Luminance When LCD is at “Black” state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

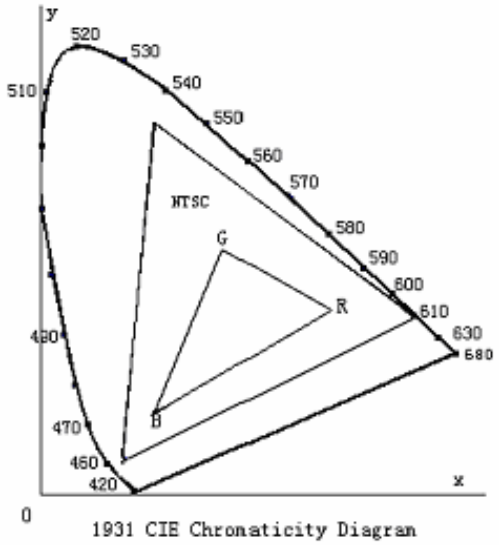
Note 5: Definition of Response time. (Test LCD using DMS501):

The output signals of photo detector are measured when the input signals are changed from “black” to “white”(falling time) and from “white” to “black”(rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.



The definition of response time

Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.



1931 CIE Chromaticity Diagram

Color gamut:

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

6. Reliability Test Items and Criteria

No	Test Item	Test condition	Criterion
1	High Temperature Storage	Ta=+80℃,240hrs	After testing, cosmetic and electrical defects should not happen.
2	Low Temperature Storage	Ta=-30℃,240hrs	
3	High Temperature Operation	Ts=+70℃,240hrs	
4	Low Temperature Operation	Ta=-20℃,240hrs	
5	High Temperature & Humidity Operation	Ta=+60℃±2℃ 90%RH 240H Power on	
6	Thermal Shock(Non-operation)	-30℃ 30 min~+70℃ 30 min,Change time:5 min,20 Cycles	
7	Vibration Test(Non-operation)	Frequency range:10~55Hz Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours For each direction of X,Y,Z. (6 hours for total)(Package condition)	
8	Shock Test(Non-operation)	60G 6ms,±X, ±Y, ±Z 3 times, for each direction	
9	Drop Test(package state)	Height:80 cm,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.

Note 1:Ts is the temperature of panel's surface.
Note 2:Ta is the ambient temperature of sample.
Note 3:Additional test Item proposed by customer shall be determined by mutual agreement between customer and Tianma

7 Quality level

7.1 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.

7.2 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): -mm X2(A.A~V.A):-mm

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

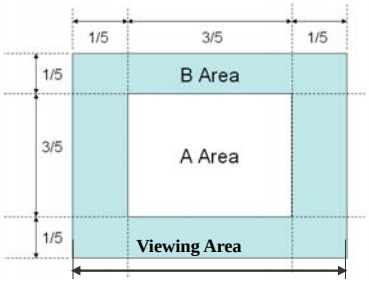


Figure 1

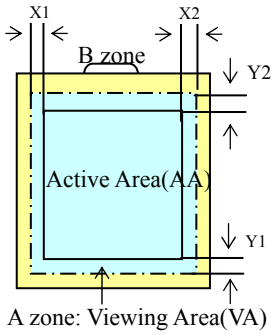


Figure 2

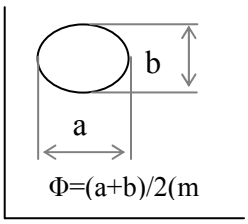
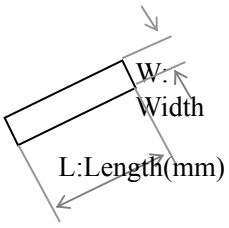
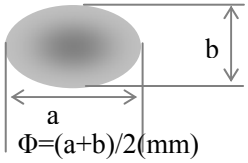
7.3 Inspection items and general notes

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: 250 mm (from the sample) Temperature : 25±5 ºC Inspection angle : 45 degrees in 12 o'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
	Dot defect (TFT LCD)	The pixel appears bright or dark abnormally when display
	Functional defect	No display, Abnormal display, Open or missing segment, Short circuit, False viewing direction
	Glass defect	Glass crack, Shaved corner of glass, Surplus glass
	PCB defect	Components assembly defect

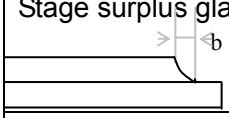
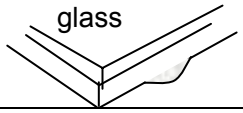
7.4 Outgoing Inspection level

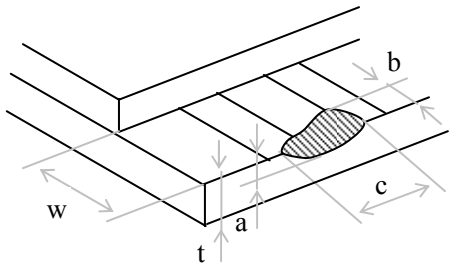
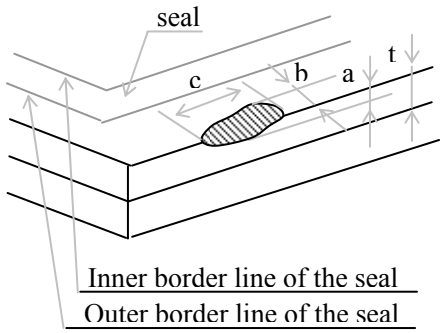
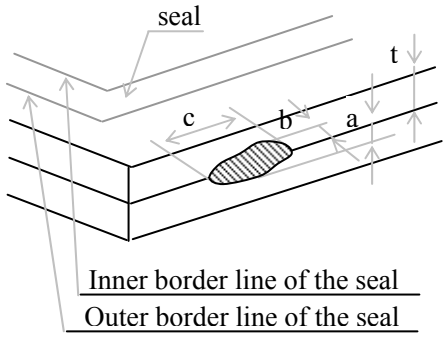
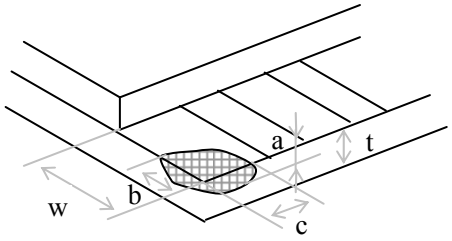
Outgoing Inspection standard	Inspection conditions	Inspection				
		Min.	Max.	Unit	IL	AQL
Major Defects	See 8.3 general notes	See 8.5			II	0.65
Minor Defects	See 8.3 general notes	See 8.5			II	1.5
Note：Sampling standard conforms to GB2828						

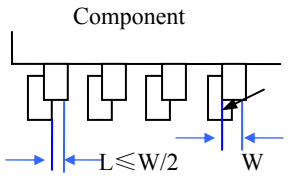
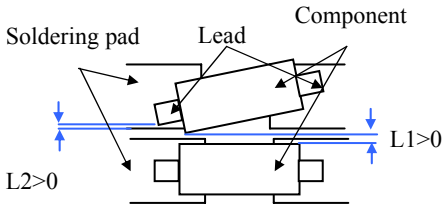
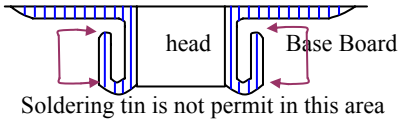
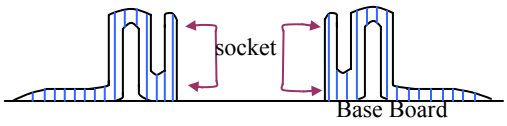
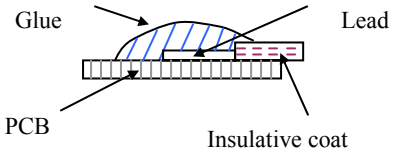
7.5 Inspection Items and Criteria

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≦0.15	2	
			C	0.15<Φ≦0.20	1	
			D	0.20<Φ	0	
			Total defective point(B,C)		3	
2	Black line, White line, and Particle Between Polarizer and glass, Scratch on glass		A	W≦0.01	Neglected	Neglected
			B	0.01<W≦0.03 L≦3.0	2	
			C	0.03<W≦0.05 L≦3.0	1	
			D	0.05<W	0	
			Total defective point(B,C)		3	
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	Dot defect (if TFT LCD is used)	TFT LCD is smaller than 3 inches	LCD Class	Defect	A area		B area
			A	Bright dot	1		Neglected
				Dark dot	1		
				Total	2		
		TFT LCD between 3~10.4 inches	LCD Class	Defect	A area	B area	C area
			B	Bright dot	2	2	Neglected
				Dark dot	2	3	

<table>
<tr><td></td><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
<tr><td></td><td></td><td colspan="5">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.
The distance of two dot: L>5mm.</td></tr>
<tr><td>5</td><td colspan="2">Bubble inside cell</td><td colspan="2">any size</td><td>none</td><td>none</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Polarizer defect (if Polarizer is used)</td><td>Scratch ,damage on polarizer, Particle on polarizer or between polarizer and glass.</td><td colspan="4">Refer to item 1 and item 2.</td></tr>
<tr><td rowspan="3">Bubble, dent and convex</td><td>A</td><td>Φ≦0.3</td><td>Neglected</td><td rowspan="3">Neglected</td></tr>
<tr><td>B</td><td>0.3<Φ≦0.7</td><td>2</td></tr>
<tr><td>C</td><td>0.7<Φ</td><td>0</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Surplus glass</td><td>Stage surplus glass  </td><td colspan="4">b≦0.3mm</td></tr>
<tr><td>Surrounding surplus glass  </td><td colspan="4">Should not influence outline dimension and assembling.</td></tr>
<tr><td>8</td><td colspan="2">Open segment or open common</td><td colspan="4">Not permitted</td></tr>
<tr><td>9</td><td colspan="2">Short circuit</td><td colspan="4">Not permitted</td></tr>
<tr><td>10</td><td colspan="2">False viewing direction</td><td colspan="4">Not permitted</td></tr>
<tr><td>11</td><td colspan="2">Contrast ratio uneven</td><td colspan="4">According to the limit specimen</td></tr>
<tr><td>12</td><td colspan="2">Crosstalk</td><td colspan="4">According to the limit specimen</td></tr>
<tr><td>13</td><td colspan="2">Black /White spot(display)</td><td colspan="4">Refer to item 1</td></tr>
<tr><td>14</td><td colspan="2">Black /White line(display)</td><td colspan="4">Refer to item 2</td></tr>
</table>

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	 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.	

8. Precautions for Use of LCD Modules

8.1 Handling Precautions

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

8.1.2 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.

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

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

8.1.5 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

8.1.6 Do not attempt to disassemble the LCD Module.

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

8.1.8 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.

8.2 Storage precautions

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

8.2.2 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%

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

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