SPECIFICATION FOR LCD MODULE

Model No. TM9664FKIWG-1

Prepared by:	**Date:**
Checked by :	**Date:**
Verified by :	**Date:**
Approved by:	**Date:**

TIANMA MICROELECTRONICS CO., LTD

Ver.1.0

REVISION RECORD

Date	Rev.No.	Revision Items	Prepared	Checked	Approved

CONTENTS

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1.General Specifications

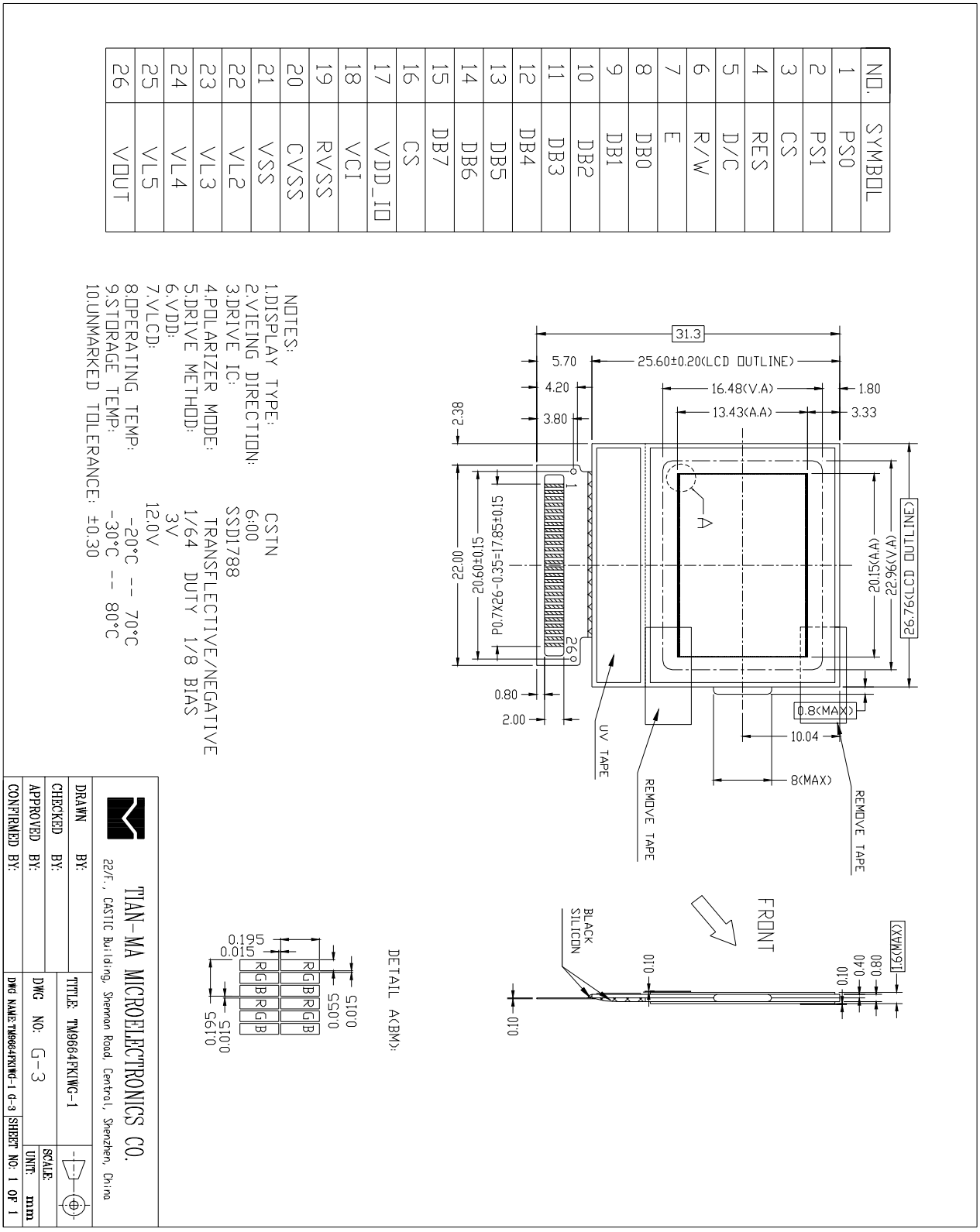
Item	Contents	Unit	Note
LCD Type	Color STN	-	
Display color	4K		1
LCD Duty	1/64	-	
LCD Bias	1/8	-	
Viewing Direction	6:00	O'Clock	
Viewing Area(W×H)	22.96×16.48	mm	
Active Area(W×H)	20.15×13.43	mm	
Number of Dots	96(RGB)×64	mm	
Dote Size(W×H)	0.195×0.195	mm	
Dot Pitch(W×H)	0.210×0.210	mm	
Controller	SSD1788	-	
V_{DD}	3.0	V	
Vop	12.0	V	
Outline Dimensions	Refer to outline drawing on next page		
Backlight	-	-	
Operating Temperature	-20～+70℃	-	
Storage Temperature	-30～+80℃	-	
Weight	TBD	g	2
Data Transfer	8 bits parallel	-	
Polarizer Mode	Transflective/Negative	-	

Note 1:

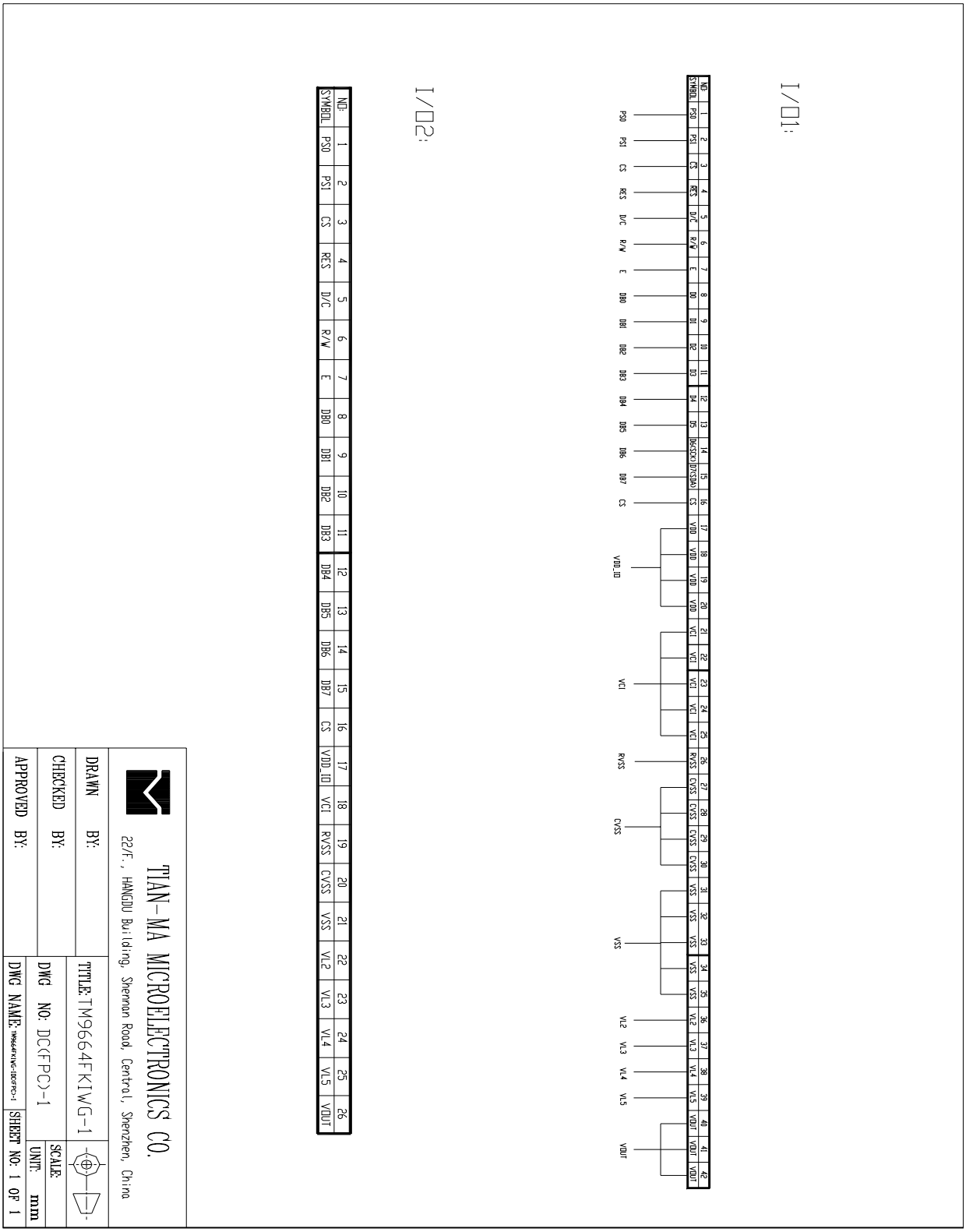
Color tune is slightly changed by temperature and driving voltage.

Note 2: TBD- To Be Determined.

2. Outline Drawing



3. Circuit Block Diagram



4. Absolute Maximum Ratings(Ta=25℃)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage(1)	V_{BAT}	3.2	4.5	V	1,2
Power Supply Voltage(2)	V_{DD}	-0.3	3.3	V	
Power Supply Voltage for LCD	Vop	11.7	12.3	V	
Logic Signal Input Voltage	V_I	-0.3	V_{DD}+0.3	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.

5. Electrical Specifications and Instruction Code

5.1 Electrical characteristics (Ta=25℃)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage		V_{BAT}	Ta=25℃	3.2	3.8	4.5	V	
Operation voltage		V_{OP}	Ta=25℃	11.7	12.0	12.3	V	1
Input voltage	‘H’	V_{IH}	V_{DD}=3.0V	0.8V_{DD}	-	V_{DD}	V	
	‘L’	V_{IL}	V_{DD}=3.0V	Vss	-	0.2V_{DD}	V	
Output Voltage	‘H’	V_{OH}	-	0.8V_{DD}	-	V_{DD}	V	
	‘L’	V_{OL}	-	Vss	-	0.2V_{DD}	V	
Current Consumption		I_{CC1}	Normal mode	-	2	3.5	mA	2
		I_{CC2}	Stand-by mode	-	-	-	mA	3

Note:

1: IC default setting, Duty:1/64,Bias:1/8.

2: Display full white.

3: IC on standby mode.

5.2 Interface Signals

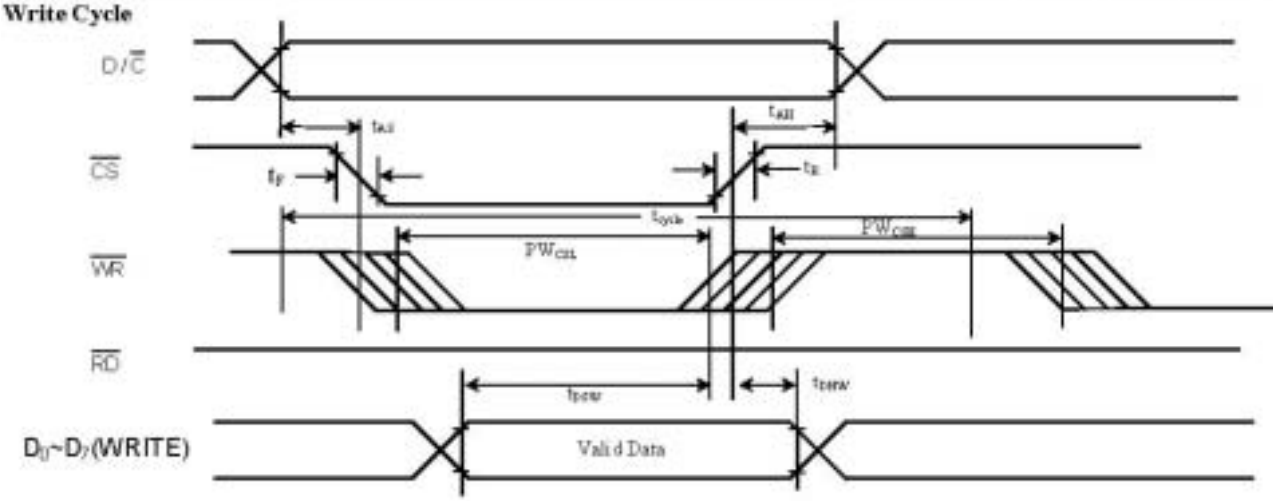
Pin No.	Symbol	I/O	Function
1	PS0	I	bus interface mode selection input
2	PS1	I	bus interface mode selection input
3	CS	I	chip selection input
4	RES	I/O	reset signal input
5	D/C	I	Data/Command control pin
6	R/W	I	Write control signal input
7	E	I	Read control signal input
8	DB0	I/O	8bits data bus
9	DB1	I/O	
10	DB2	I/O	
11	DB3	I/O	
12	DB4	I/O	
13	DB5	I/O	
14	DB6	I/O	
15	DB7	I/O	
16	CS	I/O	LCD Chip select input pin
17	VDD_IO	I	Power supply for LCM
18	VCI	I	Reference voltage input pin
19	RVSS	I	ground of Vref
20	CVSS	I/O	ground of analog
21	VSS	I/O	ground of logic
22	VL2	I/O	LCD driving voltages
23	VL3	I/O	
24	VL4	I/O	
25	VL5	I/O	
26	VOUT	I/O	

5.3 Interface Timing Chart(SSD1788 INTERFACE PROTOCOL)

Table 16 – Parallel 8080-series Interface Timing Characteristics
(T_A = -40 to 85°C, V_{DD} = 2.6V to 3.6V, V_{DDIO} = 1.2V to V_{DD})

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	130	-	-	ns
PW_{CSL}	Control Pulse Low Width	65	-	-	ns
PW_{CSH}	Control Pulse High Width	65	-	-	ns
t_{AS}	Address Setup Time	15	-	-	ns
t_{AH}	Address Hold Time	10	-	-	ns
t_{DSW}	Data Setup Time	10	-	-	ns
t_{DHW}	Data Hold Time	20	-	-	ns
t_{ACC}	Data Access Time	15	-	170	ns
t_{OH}	Output Hold time	20	-	60	ns

Write Cycle



Read Cycle

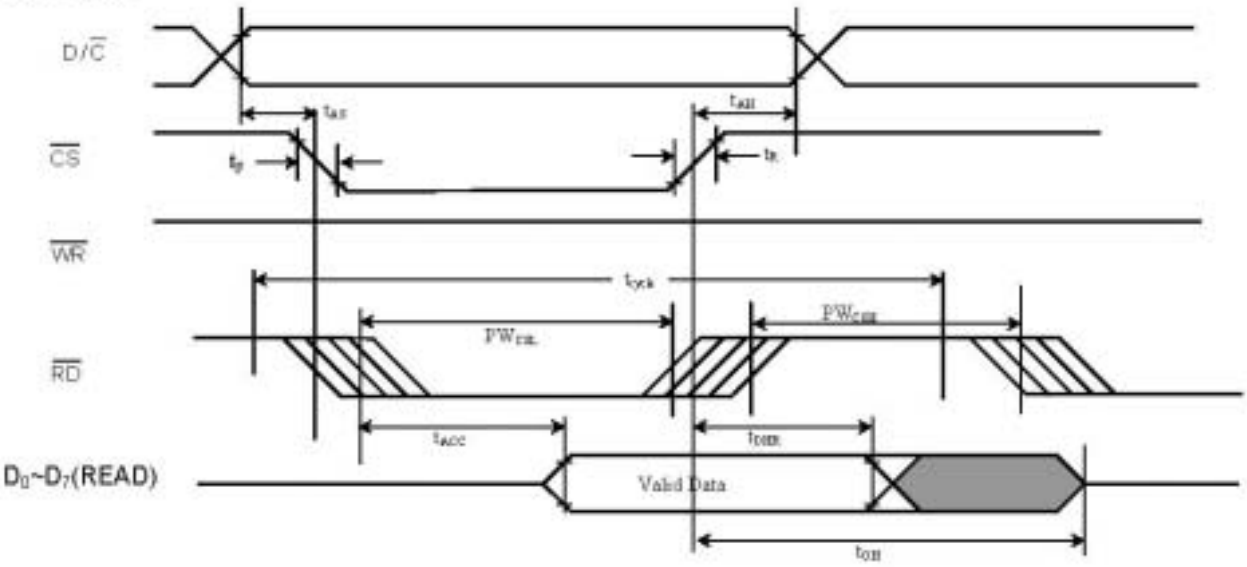


Figure 20 – Parallel 8080-series Interface Timing Characteristics (PS0 = H, PS1 = L)

5.5 COMMAND TABLE

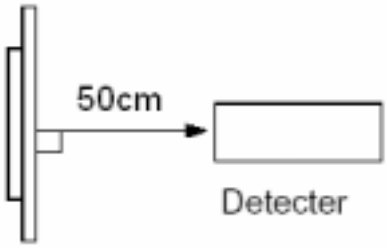
Command Table (D/ $\overline{C}$ = 0, R/$\overline{W}$ ($\overline{WR}$) = 0, E=1($\overline{RD}$ = 1) unless specific setting is stated)

D/C	Hex	D7	D6	D5	D4	D3	D2	D1	D0	Command	Description
0 1 1	15	0 X_7 Y_7	0 X_6 Y_6	0 X_5 Y_5	1 X_4 Y_4	0 X_3 Y_3	1 X_2 Y_2	0 X_1 Y_1	1 X_0 Y_0	Set Column Address	Set the start column address by $X_7X_6X_5X_4X_3X_2X_1X_0$ Set the end column address by $Y_7Y_6Y_5Y_4Y_3Y_2Y_1Y_0$ Column address = 00000000b (POR) In 8-levels gray scale mode, column address is in a range of 0~97. In 16-level gray scale mode, column address is in a range of 0~48.
0 1 1	75	0 X_7 Y_7	1 X_6 Y_6	1 X_5 Y_5	1 X_4 Y_4	0 X_3 Y_3	1 X_2 Y_2	0 X_1 Y_1	1 X_0 Y_0	Set Row Address	Set the start page address by $X_7X_6X_5X_4X_3X_2X_1X_0$ Set the end page address by $Y_7Y_6Y_5Y_4Y_3Y_2Y_1Y_0$. Page address = 00000000b (POR)
0 1	BB	1 *	0 *	1 *	1 *	1 *	0 X_2	1 X_1	1 X_0	Set COM Output Scan Direction	X_2 X_1 X_0 ROW0...ROW33 ROW34...ROW67 0 0 0 COM0 ->COM33 COM34 ->COM67 (POR) 0 0 1 COM0 ->COM33 COM67 <-COM34 0 1 0 COM33<-COM0 COM34 ->COM67 0 1 1 COM33<-COM0 COM67 <-COM34
0 1 1 1	BC	1 * * *	0 * * *	1 * * *	1 * * *	1 * * *	1 P_{12} P_{22} P_{32}	0 P_{11} P_{21} P_{31}	0 P_{10} P_{20} P_{30}	Set COM Output Scan Direction	a) Normal or Reverse page/column/scan directions P_{10} = 0: set page address to normal display (POR) P_{10} = 1: set page address to inverse display P_{11} = 0: set column address to normal rotation (POR) P_{11} = 1: set column address to inverse rotation P_{12} = 0: set scan direction to column scan (POR) P_{12} = 1: set scan direction to page scan Please refer to the Figure 7 & Figure 8 on page 35 & 36 respectively for detail description of column/page scan direction modes b) RGB color arrangement P_{22}, P_{21}, P_{20}: The control bits are used for setting the (RGB) color arrangement of segment output. , 000 is the POR value. Please refer to the Figure 10 on page 37 for detail mapping of the segment output. c) Gray-scale selection P_{32} P_{31} P_{30} Gray-scale modes 0 0 1 8-levels gray scale mode (POR) 0 1 0 16-levels gray scale mode (Type A) Please refer to the Table 9 on page 37 to Table 10on page 37 for detail description of different gray-scale selection modes.

6 Optical Characteristics

Item	Symbol		**Condition**	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		Φ_1=0° Φ_2=0°	-			Cd/m^2	1
Uniformity	△Bp			70%				1,2
Viewing Angle	Φ_1(up down)		Cr≥2	-40～+35			Deg	3
	Φ_2(left right)			-30～+30				
Contrast Ratio	Cr		Φ_1=0° Φ_2=0°	30	40	60	-	4
Response Time	Tr			-	-	180	ms	5
	T_f			70	-	90		
Color of CIE Coordinate	W	x	Φ_1=0° Φ_2=0°	-	0.30	-	-	1,6
		y		-	0.36	-	-	
	R	x		-	0.53	-	-	
		y		-	0.37	-	-	
	G	x		-	0.31	-	-	
		y		-	0.51	-	-	
	B	x		-	0.16	-	-	
		y		-	0.18	-	-	
NTSC Ratio	S				25%			

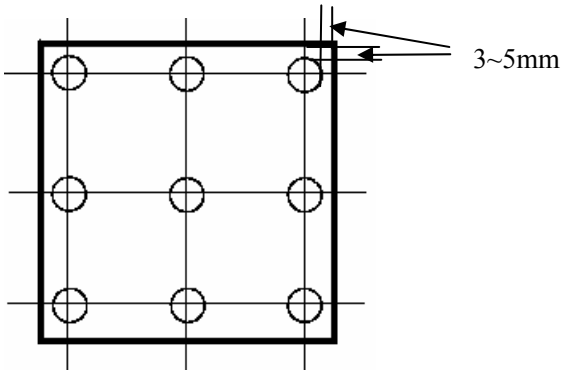
Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ10mm)



Note 2: △Bp = Bp (Min.) / Bp (Max.)×100 (%)

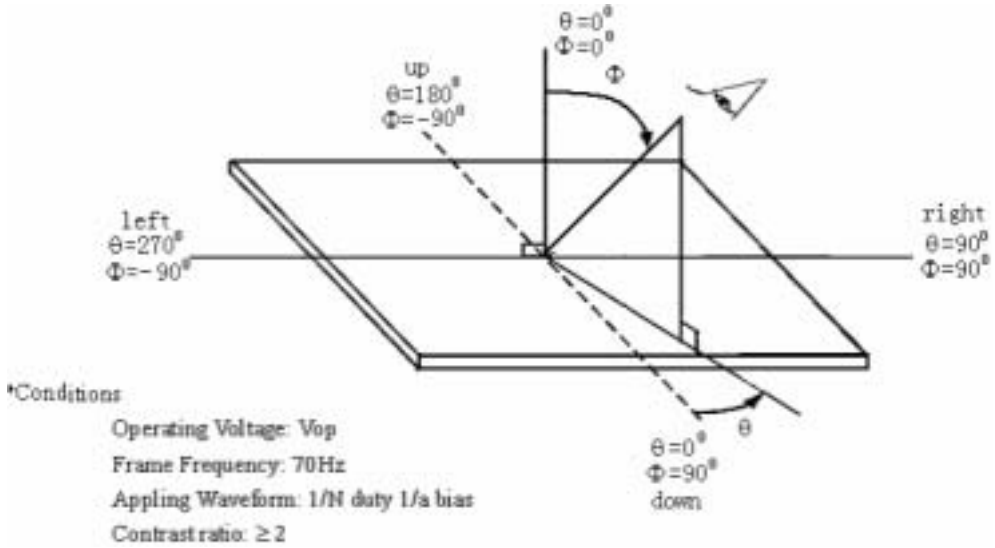
Bp (Max.) = Maximum brightness in 9 measured spots

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

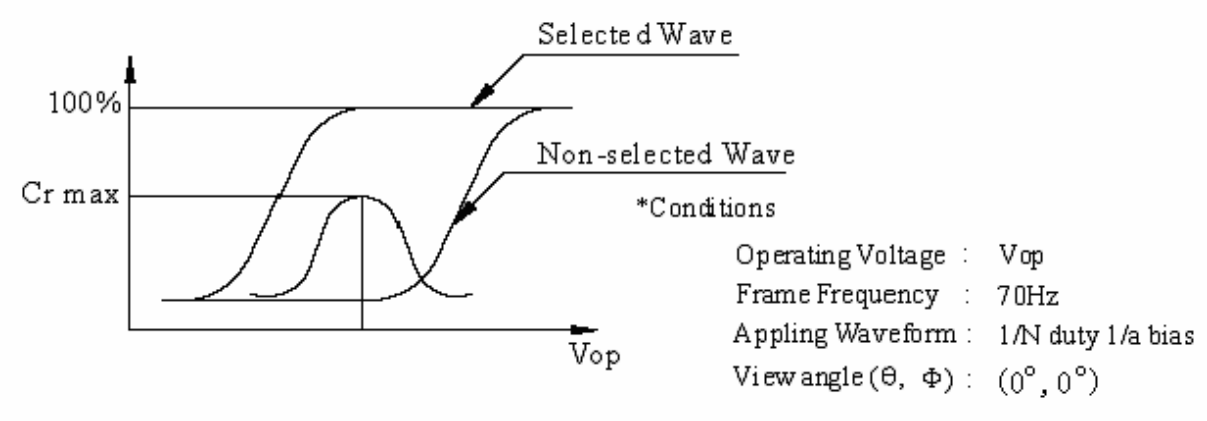


Measurement equipment PR-705 (Φ10mm)

Note 3: Definition of Viewing Angle(Test LCD using DMS501)

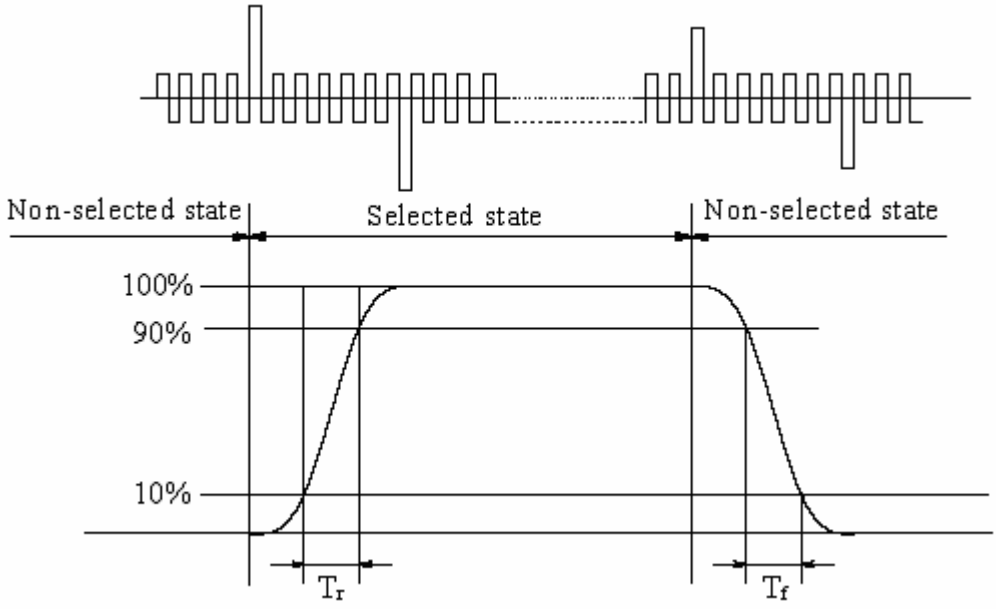


Note 4: Definition of contrast ratio.(Test LCD using DMS501)



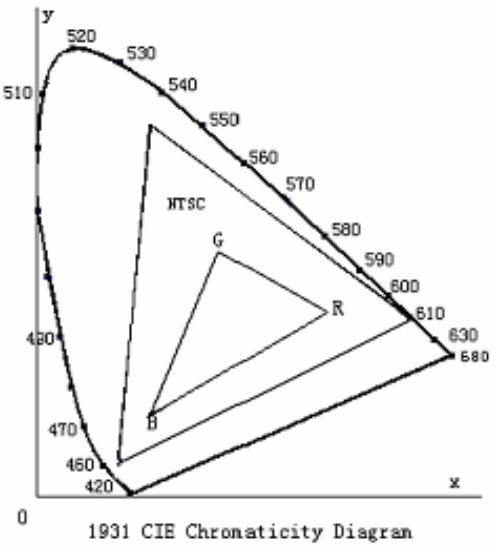
$$Contrast\ ratio(Cr) = \frac{Brightness\ of\ selected\ dots}{Brightness\ of\ non-selected\ dots}$$

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



Operating Voltage: Vop
Frame Frequency: 70Hz
Appling Waveform: 1/N duty 1/a bias
View angle (θ, Φ): $(0^0, 0^0)$

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



1931 CIE Chromaticity Diagran

Color gamut:

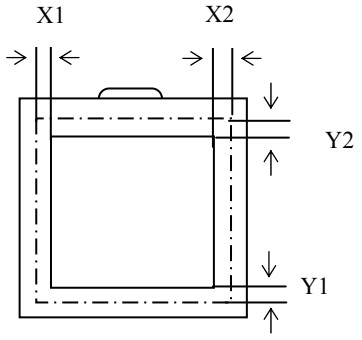
$$S = \frac{area\ \ of\ \ RGB\ \ triangle}{area\ \ of\ \ NTSC\ \ triangle} \times 100\%$$

7. Reliability

No.	Test Item	Test condition	Criterion
1	High Temperature Storage	80℃±2℃96H Restore 4H at 25℃	1. After testing, cosmetic defects should not happen. 2.Total current consumption should not be over 10% of initial value.
2	Low Temperature Storage	-30℃±2℃ 96H Restore 4H at 25℃	
3	High Temperature Operation	70℃±2℃ 48H Restore 4H at 25℃	
4	Low Temperature Operation	-20℃±2℃ 48H Restore 4H at 25℃	
5	High Temperature /Humidity Storage	40℃±2℃ 90%RH 48H	
6	Temperature Cycle	-30℃←→25℃←→80℃ 5min 30min ←→25℃, 5min after 10cycle, Restore 4H at 25℃	
7	Vibration Test (package state)	10Hz~150Hz, 100m/s2, 120min	Not allowed cosmetic and electrical defects.
8	Shock Test (package state)	Half- sine wave, 300m/s2, 18ms	
9	Atmospheric Pressure Test	25kPa 16H Restore 2H	
10	Cable Bending Test	Bending area and angle follow design document requirement	More than 50000 times

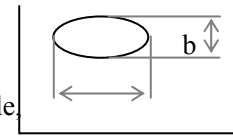
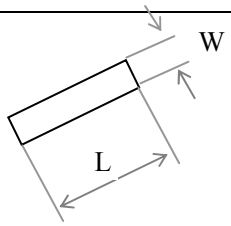
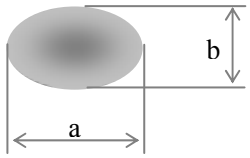
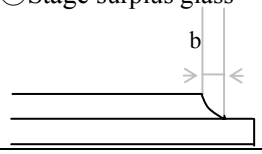
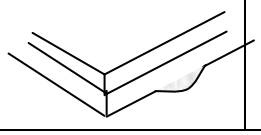
8 Quality level

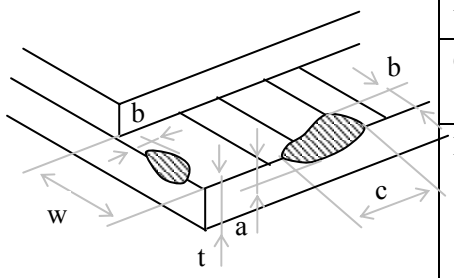
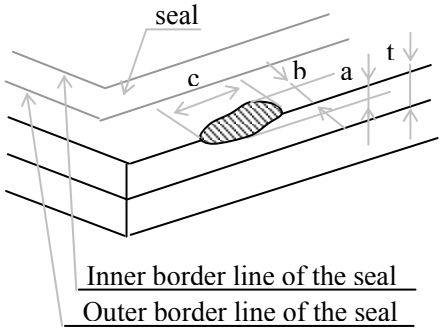
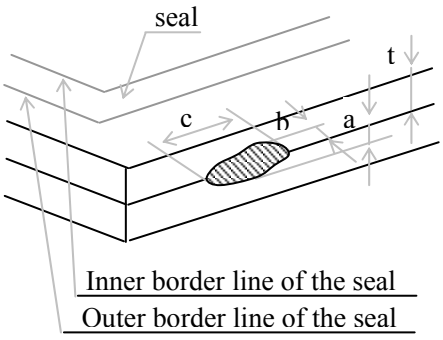
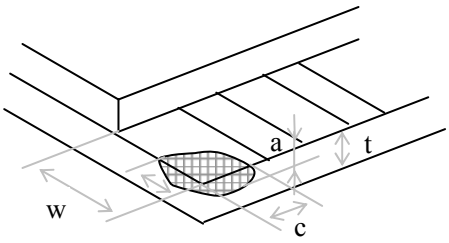
8.1 Notes for quality standard

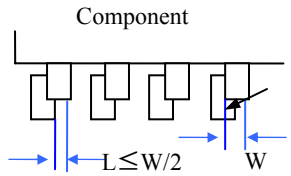
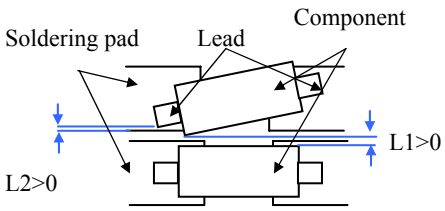
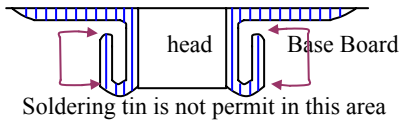
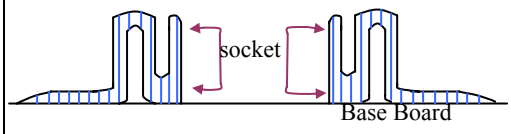
<table>
<tr><td></td><td colspan="2">Note</td></tr>
<tr><td>General</td><td colspan="2">1. Should any defects which are not specified in this standard happen, additional standard shall be determined by mutual agreement between customer and Tianma.
2. Viewing Area should be the area which Tianma guarantees.
3. Limited sample should be prior to this Inspection standard.
4. Viewing Judgement should be under static pattern.
5. Inspection conditions
Inspection distance : 250 mm (from the sample)
Temperature : 25±5℃
Inspection angle : 45degrees in LCD view direction</td></tr>
<tr><td rowspan="4">Definitions of Inspection items</td><td>Pinhole, Bright spot, Black spot, White spot, Black line, White Line, Foreign particle, Bubble</td><td>The color of a small area is different from the remainder.
The phenomenon dose not change with voltage.</td></tr>
<tr><td>Contrast variation</td><td>The color of a small area is different from the remainder.
The phenomenon changes with voltage.</td></tr>
<tr><td>Polarizer defect</td><td>Scratch, Dirt, Particle, Bubble on polarizer or between polarizer and glass.</td></tr>
<tr><td>Glass defect</td><td>Glass crack, Shaved corner of glass, Surplus glass</td></tr>
<tr><td>Definitions of Inspection ranges</td><td colspan="2"> 

Dividing A zone and B zone proceed to make a judgment.
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</td></tr>
<tr><td>Outgoing Inspection standard</td><td colspan="2">Inspection level Ⅱ Normal Inspection Sampling standard conforms to GB2828
<table>
<tr><td>Rank</td><td>Inspection Item</td><td>AQL(Number of defective LCMs counted)</td></tr>
<tr><td>Major defect</td><td>All Functional defects(Such as No display, Display abnormally, Open or missing segment, Short circuit，Missing component, No sound, Blight abnormally),Outline dimension beyond the drawing</td><td>0.65</td></tr>
<tr><td>Minor defect</td><td>Appearance defects, such as Black/White spot, Bright spot, Pinhole, Black/White line, Contrast variation, Bubble Glass defect, Polarizer defect, and so on. Details of the standard as follows.</td><td>1.50</td></tr>
</table></td></tr>
</table>

8.2Standards of inspection items

Inspection item			Judgement standard			
			Category		Acceptable number	
					A zone	B zone
1	Black spot, White spot Bright Spot, Pinhole Foreign Particle, Bubble and Particle Between polarizer and glass, Scratch on polarizer	 Φ=(a+b)/2(mm)	A	Φ≦0.15	Neglecte	Neglected
			B	0.15<Φ≦0.20	2	
			C	0.20<Φ≦0.30	1	
			D	0.30<Φ	0	
			Total defective point(B,C)		3	
2	Black line, White line, Bubble and Particle Between Polarizer and glass, Scratch on polarizer	 W:Width, L:Length(mm)	A	W≦0.10	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)		2	
3	Contrast variation	 Φ=(a+b)/2(mm)	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 and 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	
			Total defective point(B,C)		2	
6	Surplus glass	①Stage surplus glass 	b≦0.3mm			
		②Surrounding surplus glass 	Should not influence outline dimension and assembling.			

Inspection item			Judgment standard	
			Category(application: B zone)	
7	Glass defect crack	①The front of lead terminals 	A	If a ≦ t and b ≦1.0, c is not limited
			B	a ≦ t, 1≦b≦2mm, c≦3mm
			C	If glass crack cover alignment mark, b≦0.5mm.
			D	Crack at two sids 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
			*Glass crack should not cover patterns used for	

Inspection item			Judgement standard
8	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 1/2of its width; The lead burr must be less than 1/2 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 

9. Precautions for Use of LCD Modules

9.1 Handling Precautions

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

9.1.2 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.

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

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

9.1.5 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

9.1.6 Do not attempt to disassemble the LCD Module.

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

9.1.8 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.

9.2 Storage precautions

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

9.2.2 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%

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

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