SPECIFICATION FOR LCD MODULE

MODEL NO: TM9632RGFWGWC

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PREPARED	CHECKED	VERIFIED BY R&D DEPT	VERIFIED BY QC DEPT	APPROVED

REVISION RECORD

Date	Rev.No.	Revision Items	Prepared	Checked	Approved
2007.6.2	**V1.0**	**NEW**			

CONTENTS

1.General Specifications

| Item	Contents	Unit	Note
LCD Type	FSTN	-	
Display color			
LCD Duty	1/33	-	
LCD Bias	1/7	-	
Viewing Direction	6:00	O'Clock	
Viewing Area(W×H)	29.9×9.1	mm	
Active Area(W×H)	23.02×7.66	mm	
Number of Dots	96×32		
Dote Size(W×H)	0.22×0.22	mm	
Dot Pitch(W×H)	0.24×0.24	mm	
Controller	ST7579	-	
V_{DD}	3.3	V	
Vop	7.5	V	
Outline Dimensions	Refer to outline drawing on next page		
Backlight	1 LED(white)	-	
Operating Temperature	-10～+60	-	
Storage Temperature	-20～+70	-	
Weight	TBD	g	1
Data Transfer	4-LINE SPI	-	
Polarizer Mode	Transmissive/Negative	-	

Note 1:   TBD- To Be Determined.
Note 2:   Requirements on Environmental Protection:RoHS

2. Outline Drawing
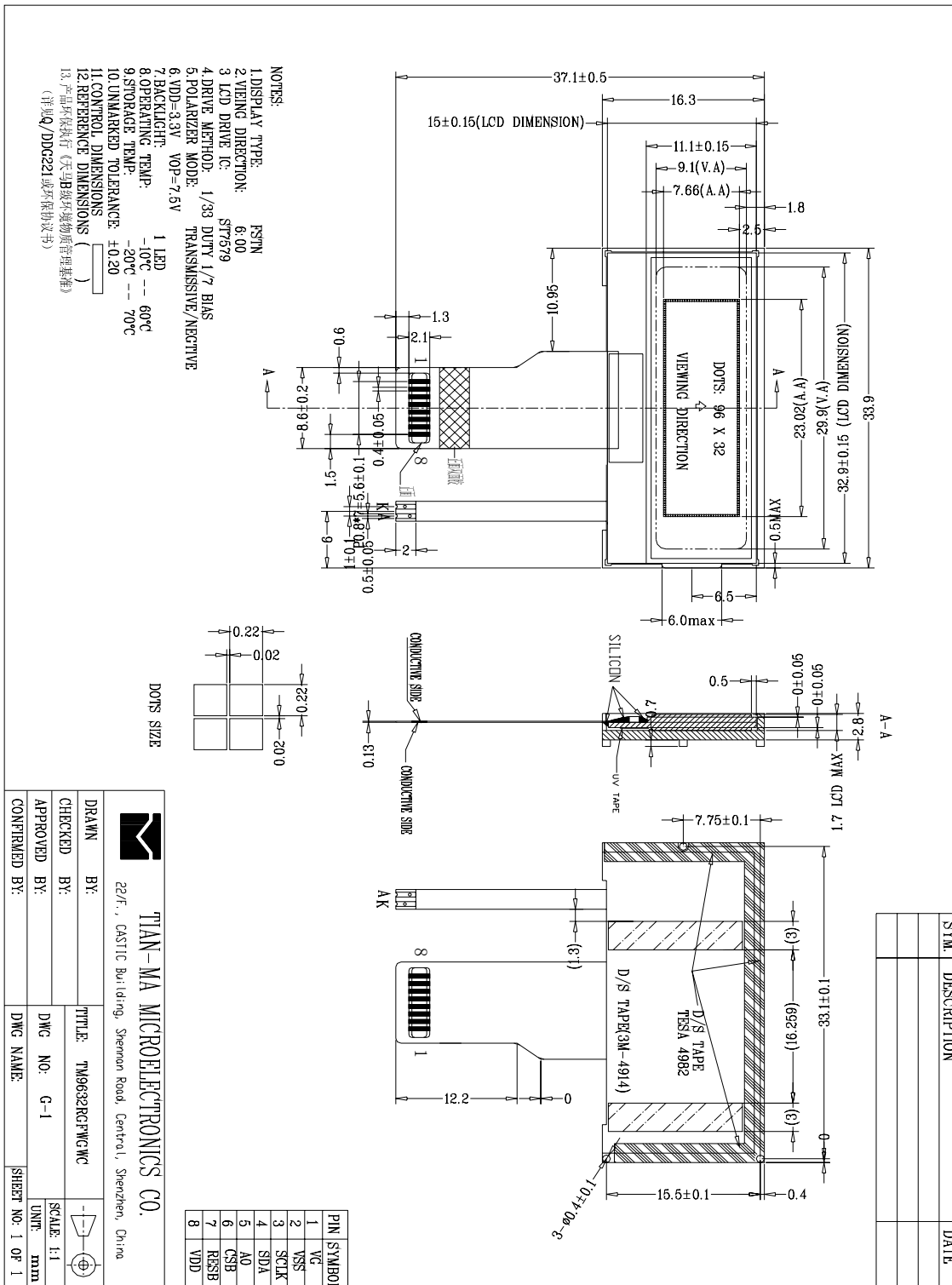
3. Circuit Block Diagram
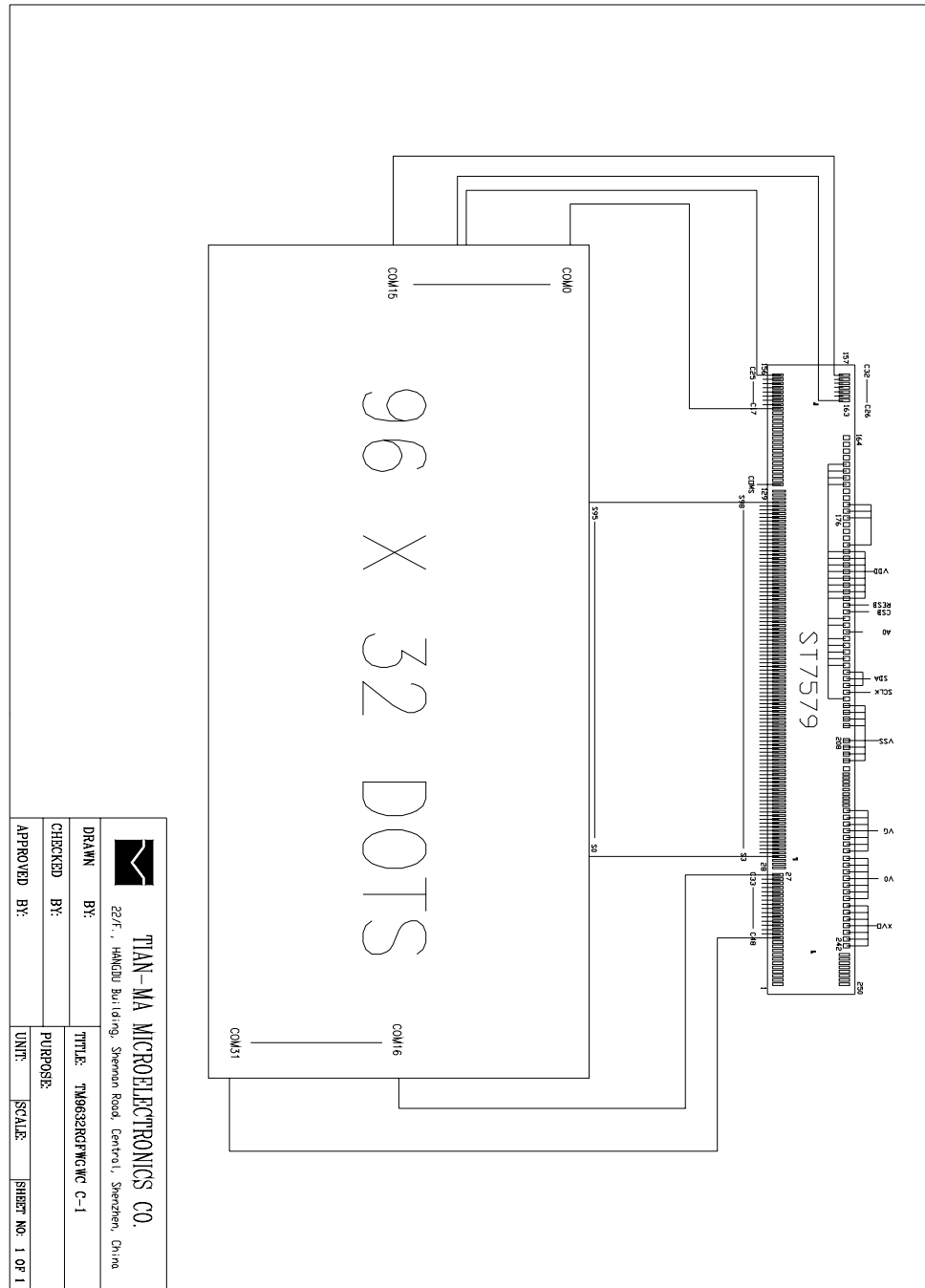
4. Absolute Maximum Ratings(Ta=25)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	-	3.3	V	
Power Supply Voltage for LCD	Vop		10	V	
Logic Signal Input Voltage	V_I	-0.3	$V_{DD}+0.3$	V	
Operating Temperature	Top	-10	+60		
Storage Temperature	Tst	-20	+70		

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
Operation voltage		V_{OP}	Ta=25	-	7.5	-	V	1
Logic Voltage supply		VDD			3.3		V	
Input voltage	'H'	V_{IH}	V_{DD}=3.3V	$0.8V_{DD}$	-	V_{DD}	V	
	'L'	V_{IL}	V_{DD}=3.3V	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	-	-	-	mA	2
		I_{CC2}	Stand-by mode	-	-	-	mA	3

Note:

    1: IC default setting, Duty:1/33,Bias:1/7.

    2: Display full white. Backlight on state.

    3: IC on standby mode.

5.2 LED backlight specification

Item		Symbol	Condition	Min	Typ	Max	Unit	Note
Forward voltage		V_f	I_f=17mA	3.0	3.2	3.4	V	
Forward current	Normal	I_{pn}	1-chip		17		mA	
	Dimming	I_{pd}						
Reverse Current		I_r	-			15	μA	
Uniformity			I_f=17mA	80%				

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5.3 Interface Signals

Pin No.	Symbol	I/O	Function
1	VG	P	LCD driving voltage for segments
2	VSS	P	Ground
3	SCLK	I/O	Serial input clock
4	SDA	I/O	Serial input data
5	A0	I	It determines whether the data bits are data or a command. A0=" H ": Indicates that D0 to D7 are display data. A0=" L ": Indicates that D0 to D7 are control data.
6	CSB	I	Chip select input pins
7	RESB	I	Reset input pin
8	VDD	I/O	Suplly voltage

5.4 Interface Timing Chart

 Note: Please refer to Sitronix's ST7579 data sheet for more details.

Sitronix's ST7579 INTERFACE PROTOCOL

Read/Write Characteristics (4-line SPI)

Fig. 2   4-line SPI Timing
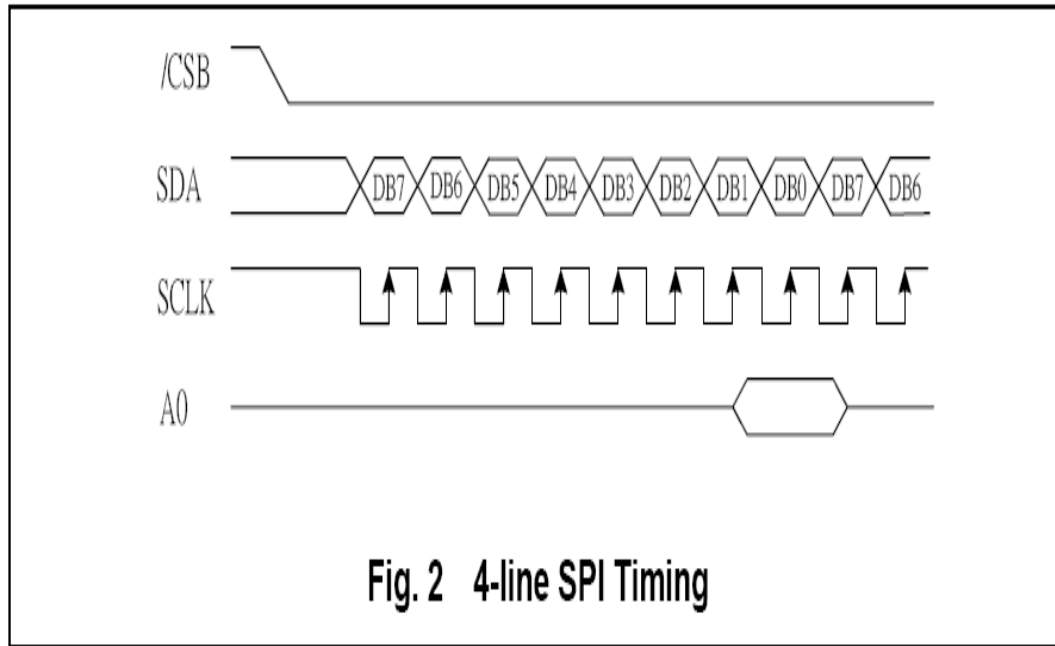
$(V_{DD}=3.3V, Ta=25℃)$

Item	Signal	Symbol	Condition	Rating Min.	Rating Max.	Units
Serial Clock Period		tSCYC		150	—	
SCL "H" pulse width	SCL	tSHW		75	—	
SCL "L" pulse width		tSLW		75	—	
Address setup time	A0	tSAS		20	—	
Address hold time		tSAH		100	—	ns
Data setup time	SI	tSDS		20	—	
Data hold time		tSDH		10	—	
CS-SCL time	CSB	tCSS		20	—	
CS-SCL time		tCSH		140	—	

8. INSTRUCTION TABLE

INSTRUCTION	A0	WR (R/W)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
H independent instruction											
NOP	0	0	0	0	0	0	0	0	0	0	No operation
Reserved	0	0	0	0	0	0	0	0	0	1	Do not use
Function set	0	0	0	0	1	MX	MY	PD	H1	H0	Power-down; entry mode; Extended instruction control
Read status byte	0	1	PD	0	0	D	E	MX	MY	DO	Read status byte
Read data	1	1	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	Read data to RAM
Write data	1	0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	Write data to RAM

INSTRUCTION	A0	WR (R/W)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
H[1:0]=[0:0]											
Reserved	0	0	0	0	0	0	0	0	1	X	Do not use
Set V_{LCD} range	0	0	0	0	0	0	0	1	0	PRS	V_{LCD} range L/H select
END	0	0	0	0	0	0	0	1	1	0	Release read/modify/write
Read/modify/write	0	0	0	0	0	0	0	1	1	1	RAM address at R:+0 , W:+1
Display control	0	0	0	0	0	0	1	D	0	E	Sets display configuration
Reserved	0	0	0	0	0	1	0	0	X	X	Do not use
Set Y address of RAM	0	0	0	1	0	0	Y_3	Y_2	Y_1	Y_0	Sets Y address of RAM $0 \leq Y \leq 9$
Set X address of RAM	0	0	1	X_6	X_5	X_4	X_3	X_2	X_1	X_0	Sets X address of RAM $0 \leq X \leq 101$
H[1:0]=[0:1]											
Reserved	0	0	0	0	0	0	0	0	1	X	Do not use
Display configuration	0	0	0	0	0	0	1	DO	X	X	Top/bottom row mode set data order
Bias system	0	0	0	0	0	1	0	BS_2	BS_1	BS_0	Sets bias system (BSx)
Set Start line	0	0	0	1	S5	S4	S3	S2	S1	S0	Specify the initial display line to realize vertical scrolling
Set V_{OP}	0	0	1	V_{OP6}	V_{OP5}	V_{OP4}	V_{OP3}	V_{OP2}	V_{OP1}	V_{OP0}	Write V_{OP} to register

INSTRUCTION	A0	WR (R/W)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
H[1:0]=[1:0]											
Reserved	0	0	0	0	0	0	0	0	1	X	Do not use
Partial screen mode	0	0	0	0	0	0	0	1	0	PS	Partial screen enable
Partial screen size	0	0	0	0	0	0	1	0	0	WS	Set partial screen size
Display part	0	0	0	0	0	1	0	DP2	DP1	DP0	Set display part for partial screen mode
H[1:0]=[1:1]											
RESET	0	0	0	0	0	0	0	0	1	1	Software reset
Display control	0	0	0	0	0	0	1	FR2	FR1	FR0	Frame rate control
N line inversion	0	0	0	1	0	NL4	NL3	NL2	NL1	NL0	Sets N line inversion
Booster Efficiency &Booster Stage	0	0	1	0	0	1	BE1	BE0	PC1	PC0	Booster Efficiency Set
Reserved	0	0	1	X	X	X	X	X	X	X	Do not use

6. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		$\Phi_1=0°$ $\Phi_2=0°$	120			Cd/m^2	1
Uniformity	$\triangle$Bp			80%				1,2
Viewing Angle	Φ_1(up down)		Cr≥2	-40～+35			Deg	3
	Φ_2(left right)			-30～+30				
Contrast Ratio	Cr		$\Phi_1=0°$ $\Phi_2=0°$	30	40	60	-	4
Response Time	Tr			-	-	180	ms	5
	T_f			70	-	90		
Color of CIE Coordinate	W	x	$\Phi_1=0°$ $\Phi_2=0°$	-	TBD	-	-	1,6
		y		-	TBD	-	-	
	R	x		-	TBD	-	-	
		y		-	TBD	-	-	
	G	x		-	TBD	-	-	
		y		-	TBD	-	-	
	B	x		-	TBD	-	-	
		y		-	TBD	-	-	
NTSC Ratio	S							

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)
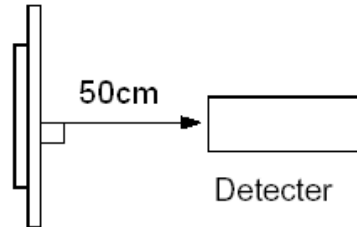
Note 2: $\triangle Bp = Bp$ (Min.) / Bp (Max.)×100 (%)

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

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

3~5mm
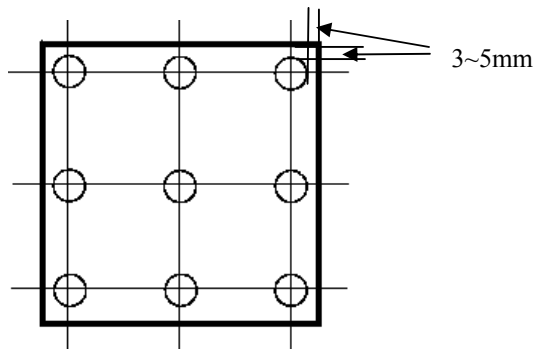
Measurement equipment PR-705 (Φ10mm)

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

$\theta=0^0$
$\Phi=0^0$

up
$\theta=180^0$
$\Phi=-90^0$

Φ

left
$\theta=270^0$
$\Phi=-90^0$

right
$\theta=90^0$
$\Phi=90^0$

$\theta=0^0$
$\Phi=90^0$
down

θ

*Conditions

Operating Voltage: Vop

Frame Frequency: 70Hz

Appling Waveform: 1/N duty 1/a bias
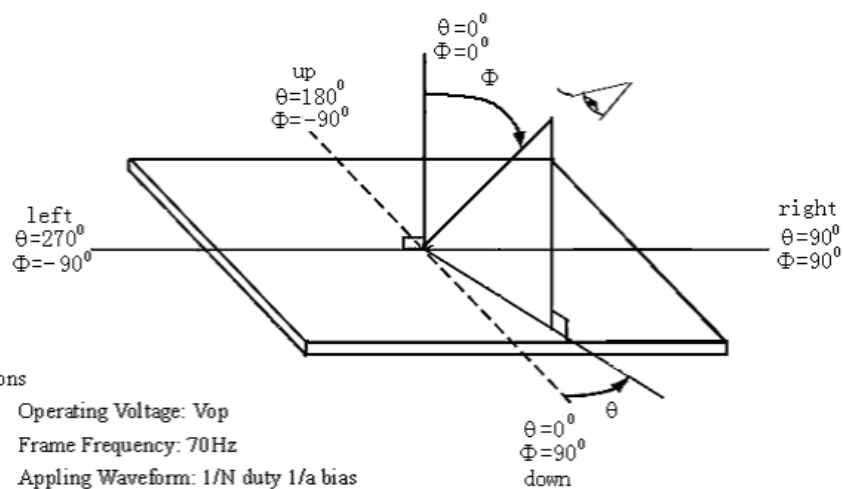
Contrast ratio: ≥ 2

Note 4: Definition of contrast ratio.(Test LCD using DMS501)
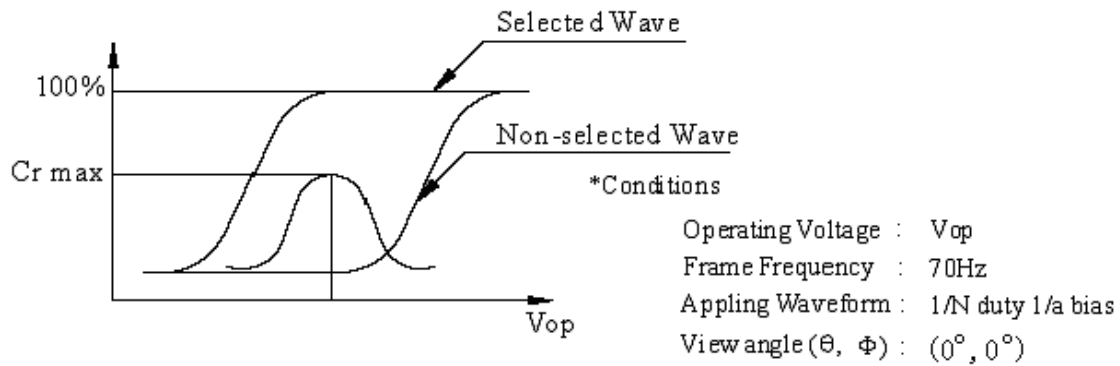
$$Contrast\ ratio(Cr) = \frac{Brightness\ of\ selected\ dots}{Brightness\ of\ non-selected\ dots}$$

Note 5: Definition of Response time(Test LCD using DMS501)
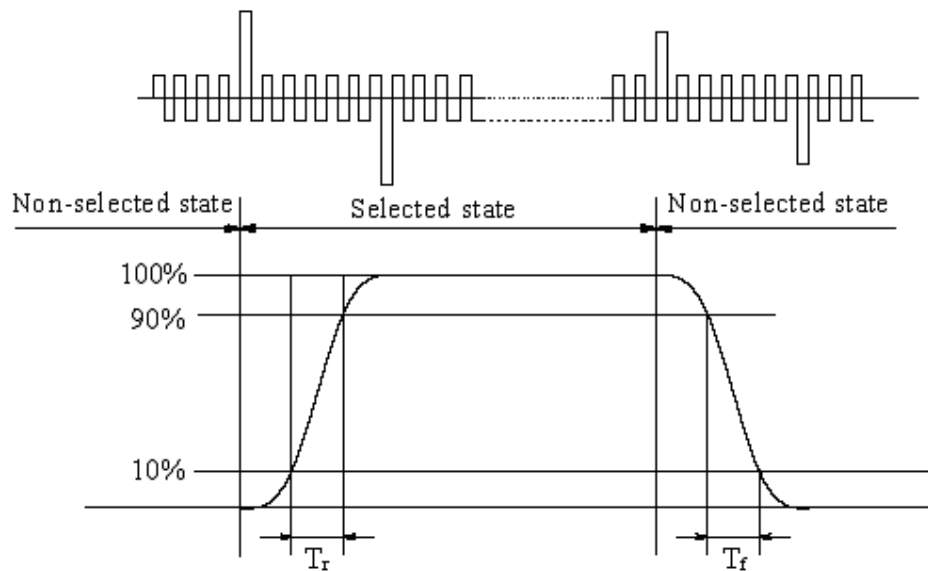
Operating Voltage: Vop
Frame Frequency: 70Hz
Appling Waveform: 1/N duty 1/a bias
View angle (θ, Φ):   (0^0, 0^0)

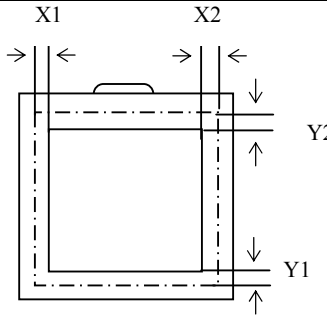Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.

1931 CIE Chromaticity Diagram
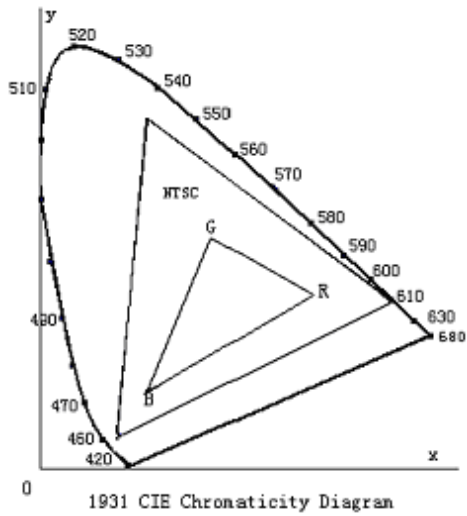
Color gamut:

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

7. Reliability
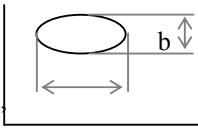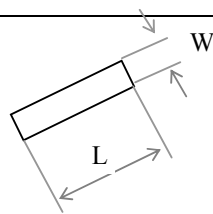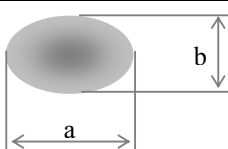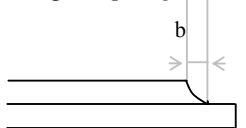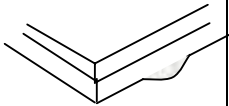
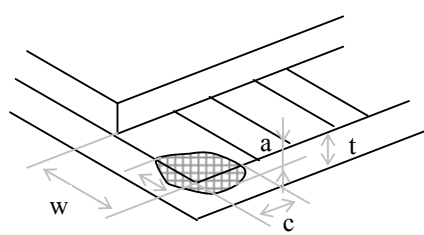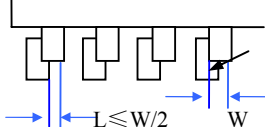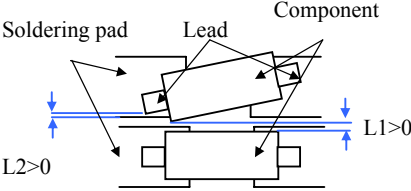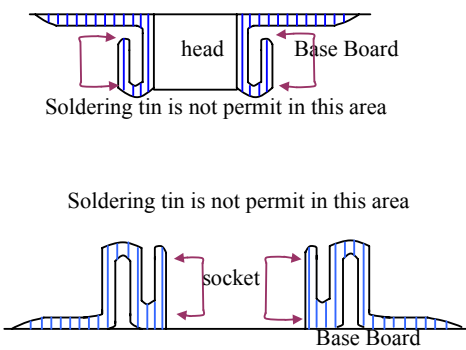| No.	Test Item	Test condition	Criterion
1	High Temperature Storage	70 ±2 96H Restore 4H at 25	1. After testing, cosmetic defects should not happen. 2.Total current consumption should not be over 10% of initial value.
2	Low Temperature Storage	-20 ±2 96H Restore 4H at 25	
3	High Temperature Operation	60 ±2 48H Restore 4H at 25	
4	Low Temperature Operation	-10 ±2 48H Restore 4H at 25	
5	High Temperature /Humidity Storage	40 ±2 90%RH 48H	

6	Temperature Cycle	-20 ←→25 ←→70
		    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	
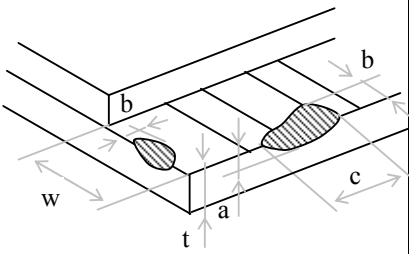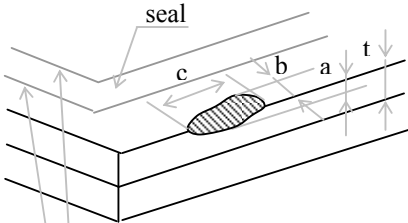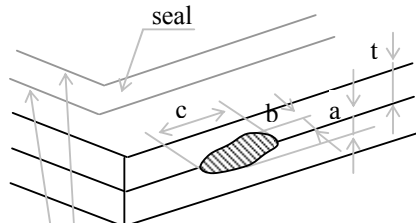
8 Quality level

8.1 Notes for quality standard

	Note

General	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

Definitions of 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 dose not 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.
	Glass defect	Glass crack, Shaved corner of glass, Surplus glass

Definitions of Inspection ranges	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

Outgoing Inspection standard	Inspection level Normal Inspection Sampling standard conforms to GB2828		
	Rank	Inspection Item	AQL(Number of defective LCMs counted)
	Major defect	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	0.65
	Minor defect	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.	1.50

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	Stage surplus glass	b 0.3mm			
		Surrounding surplus glass	Should not influence outline dimension and assembling.			

Inspection item				Judgment standard	
				Category(application: B zone)	
7	Glass defect crack	The 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	
		Surrounding crack—non-contact side	b < Inner borderline of the seal		
		Surrounding crack— contact side	b < Outer borderline of the seal		
		Corner	A	a t, b 3.0, c 3.0	
			*Glass crack should not cover patterns used for		

Diagram labels (front of lead terminals): b, b, w, a, t, c

Diagram labels (Surrounding crack—non-contact side): seal, c, b, a, t, Inner border line of the seal, Outer border line of the seal

Diagram labels (Surrounding crack— contact side): seal, t, c, b, a, Inner border line of the seal, Outer border line of the seal

Diagram labels (Corner): a, t, w, c

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）	Component $L \leqslant W/2$ W Soldering pad Lead Component $L1>0$ $L2>0$
		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	head Base Board Soldering tin is not permit in this area Soldering tin is not permit in this area socket Base Board

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.