



MODEL NO. : TS022GAACB06-00

ISSUED DATE: 2008-02-01

VERSION : Ver 1.0

- Preliminary Specification
- Final Product Specification

Customer : _____

Approved by	Notes

SHANGHAI TIANMA Confirmed :

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1 General specifications

Feature		Spec
Display Spec.	Size	2.2"
	Resolution	176(RGB) X 220
	Interface	CPU 18/8 bit
	Color Depth	262K/65K
	Technology type	a-si TFT
	Pixel pitch (mm)	0.198x0.198
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	TM with Normally White
	Surface Treatment(Up Polarizer)	Clear type (3H)
	Surface Treatment(Up TSP)	Clear type (3H)
	Viewing Direction	6 o'clock
	Gray Scale Direction	12 o'clock
Mechanical Characteristics	DIM. LCM (W x H x D) (mm)	41.7x56.16x3.6
	Active Area(mm)	34.848x43.56
	With /Without TSP	WITH TSP
	Weight (gram)	TBD.
	LED Numbers	3 LEDs (in parallel)
Electronic	Driver IC	NT39115

Note 1 : Viewing direction for best image quality is different from TFT definition, there is a 180 degree shift.

Note 2 : Requirements on Environmental Protection: RoHS



2 Input/Output terminals

2.1 TFT LCD Panel

No	Symbol	I/O	Description	Remark
1	DB15	I	Data Bus	
2	DB14	I	Data Bus	
3	DB13	I	Data Bus	
4	DB12	I	Data Bus	
5	DB11	I	Data Bus	
6	DB10	I	Data Bus	
7	DB9	I	Data Bus	
8	DB8	I	Data Bus	
9	GND	P	Ground	
10	DB7	I	Data Bus	
11	DB6	I	Data Bus	
12	DB5	I	Data Bus	
13	DB4	I	Data Bus	
14	DB3	I	Data Bus	
15	DB2	I	Data Bus	
16	DB1	I	Data Bus	
17	DB0	I	Data Bus	
18	IOVCC	P	Power Supply	
19	VCI/VCC	P	Power Supply	
20	/RD	I	Read signal Read:rising edge(/WR='1')	
21	/WR	I	Write signal Write:rising edge(/RD='1')	
22	RS	I	Register select low: Index high:Data	
23	/CS	I	Chip selection Active low	
24	/RESET	I	Reset signal Active low	
25	IM0	I	Mode select	Note 2-2
26	GND	P	Ground	
27	LED_A	P	Led Power	Note 2-3
28	LED_K1	P	Led Power	Note 2-3
29	LED_K2	P	Led Power	Note 2-3
30	LED_K3	P	Led Power	Note 2-3
31	Y+	O	Touch Panel signal: Top	
32	Y-	O	Touch Panel signal: Down	
33	X+	O	Touch Panel signal: Right	
34	X-	O	Touch Panel signal: Left	
35	NC	-		
36	NC	-		

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Note2-1: I/O definition:

I----Input

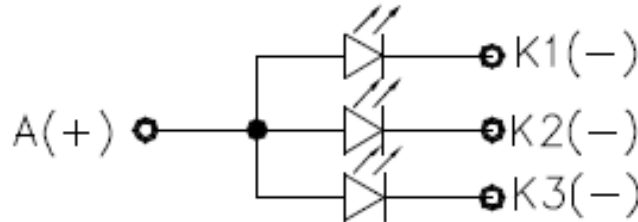
O---Output

P----Power

Note2-2: Data mode select:

IM0	Interface	DB pin
1	8080 MCU 8-bit Parallel	DB17~10
0	8080 MCU 16-bit Parallel	DB17~10;DB8~1

Note2-3: Figure below shows the connection of backlight LED.





3 Absolute maximum ratings

3.1 Driving TFT LCD Panel

Ta = 25°C

Item	Symbol	MIN	MAX	Unit	Remark
Logic Supply Voltage	IOVCC	-0.3	4.6	V	
Analog Supply Voltage	VCC/VCI	-0.3	4.6	V	
Input Signal Voltage	VIN	-0.3	IOVCC +0.3	V	
Back Light Forward Current	I _{LED}	--	25	mA	For each LED
Operating Temperature	T _{OPR}	-20	70	°C	
Storage Temperature	T _{STG}	-30	80	°C	



4 Electrical characteristics

4.1 Driving TFT LCD Panel

GND=0V, Ta=25°C

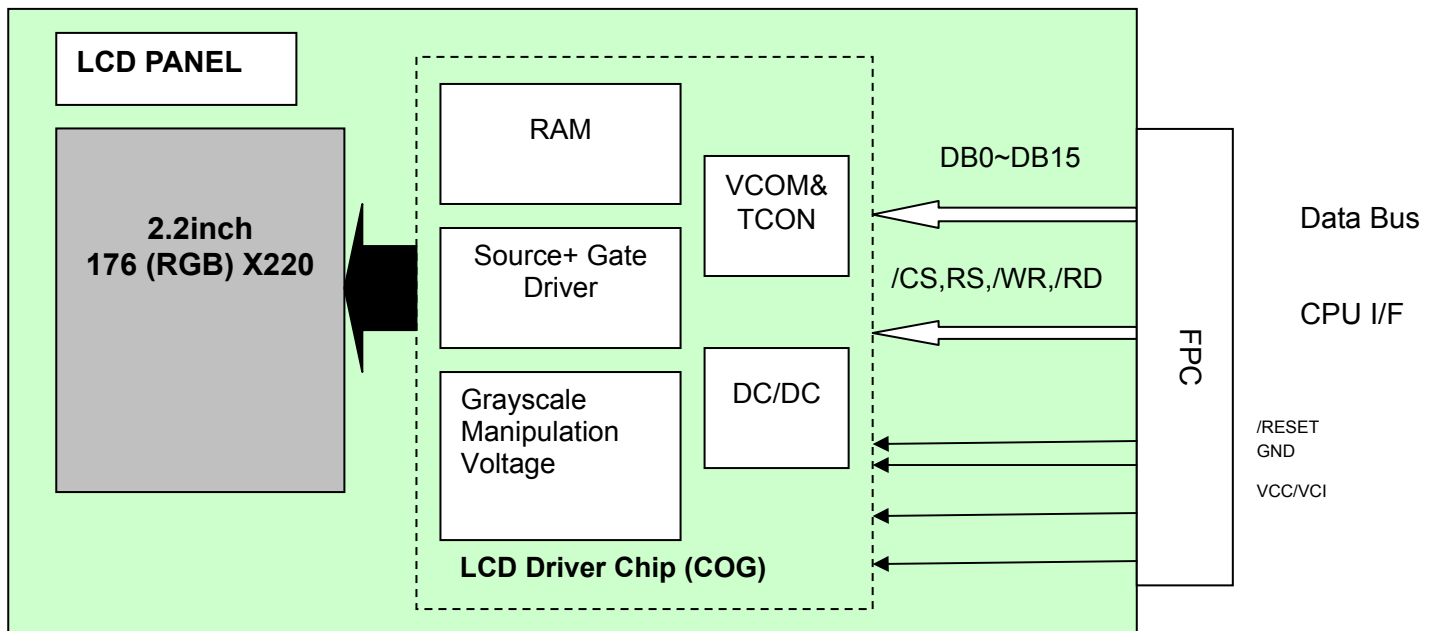
Item	Symbol	MIN	TYP	MAX	Unit	Remark	
Logic Supply Voltage	IOVCC	1.7	2.8	3.3	V		
Analog Supply Voltage	VCC/VCI	2.7	2.8	2.9	V		
Input Signal Voltage	Low Level	V_{IL}	0	--	0.2* IOVCC	V	DB0~DB15,/CS,RS,/WR, /RD,/RESET
	High Level	V_{IH}	0.8* IOVCC	--	IOVCC		
Output Signal Voltage	Low Level	V_{OL}	--	--	0.3* IOVCC	V	
	High Level	V_{OH}	0.7* IOVCC	--	IOVCC		
(Panel+ LSI) Power Consumption	Black Mode (60Hz)	--	TBD	--	mW		
	Standby Mode	--	TBD	--	mW		
	Sleeping Mode	--	TBD	--	mW		

4.2 Driving Backlight Ta=25°C

Item	Symbol	MIN	TYP	MAX	Unit	Unit
Forward Current	I_F	--	20	25	mA	For each LED
Forward Voltage	V_F	--	3.2	--	V	3 LEDs (in parallel)
Power Consumption	W_{BL}	--	192	--	mW	



4.3 Block Diagram





5 Timing chart

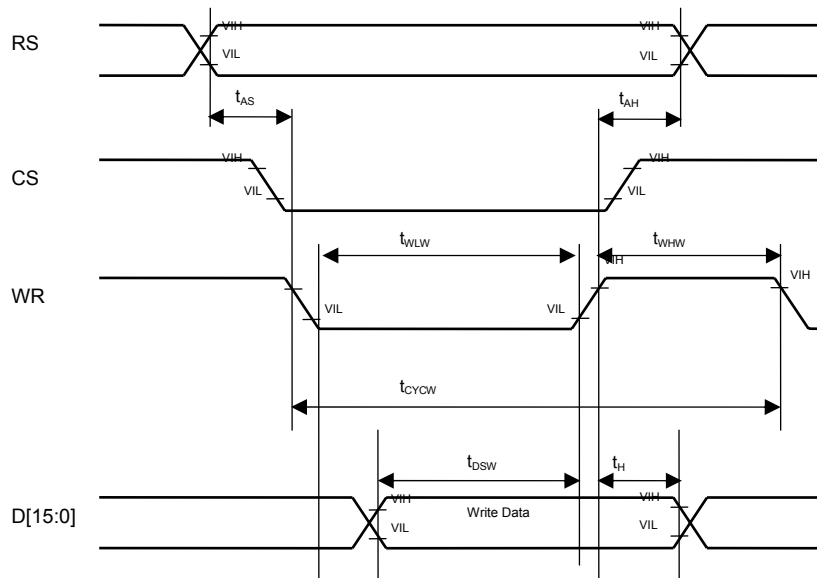
5.1 8080 MCU system

5.1.1 8080 MCU system timing parameter

Normal Write Mode (VCC=2.5~3.3V)

Item	Symbol	Unit	Min.	Typ.	Max.	Test Condition
Bus cycle time	Write	t_{CYCW}	ns	100	-	-
Write low-level pulse width		t_{WLLW}	ns	35	-	-
Write high-level pulse width		t_{WHW}	ns	35	-	-
Setup time	Write (RS to CS, WR)	t_{AS}	ns	10	-	-
Address hold time		t_{AH}	ns	10	-	-
Write data set up time		t_{DSW}	ns	10	-	-
Write data hold time		t_H	ns	10	-	-

5.1.2 8080 MCU system bus timing





5.1.3 8080 MCU system interface with 8-bit data bus

Register Command		DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Register	
		0	0	1	0	1	1	0	0	x	x	x	x	x	x	x	x	x	x	2Ch	
IFPF[2:0]		DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Colour	
011	3	R3	R2	R1	R0	G3	G2	G1	G0	x	x	x	x	x	x	x	x	x	x	4K-Colour (2-pixels/ 3-byyes)	
		B3	B2	B1	B0	R3	R2	R1	R0	x	x	x	x	x	x	x	x	x	x		
		G3	G2	G1	G0	B3	B2	B1	B0	x	x	x	x	x	x	x	x	x	x		
101	5	R4	R3	R2	R1	R0	G5	G4	G3	x	x	x	x	x	x	x	x	x	x	65K-Colour (1-pixels/ 2-byyes)	
		G2	G1	G0	B4	B3	B2	B1	B0	x	x	x	x	x	x	x	x	x	x		
110	6	R5	R4	R3	R2	R1	R0	x	x	x	x	x	x	x	x	x	x	x	x	262K-Colour (1-pixels/ 3byyes)	
		G5	G4	G3	G2	G1	G0	x	x	x	x	x	x	x	x	x	x	x	x		
		B5	B4	B3	B2	B1	B0	x	x	x	x	x	x	x	x	x	x	x	x		

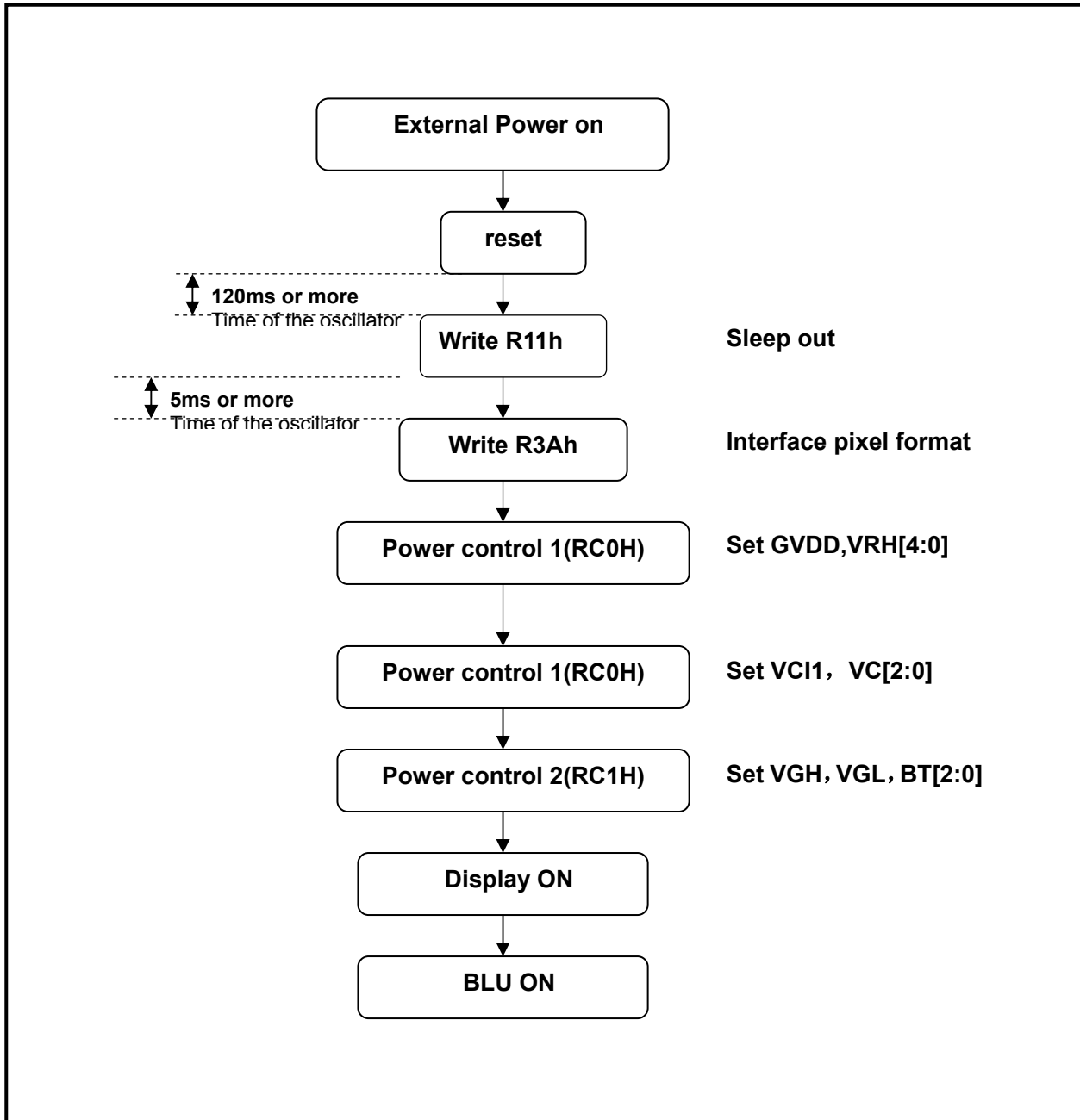
5.1.4 8080 MCU system interface with 8-bit data bus

Register Command		DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Register	
		x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0	x	2Ch	
IFPF[2:0]		DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Colour	
011	3	x	x	x	x	R3	R2	R1	R0	x	G3	G2	G1	G0	B3	B2	B1	B0	x	4K-Colour	
101	5	R4	R3	R2	R1	R0	G5	G4	G3	x	G2	G1	G0	B4	B3	B2	B1	B0	x	65K-Colour	
110	6	R5	R4	R3	R2	R1	R0	x	x	x	G5	G4	G3	G2	G1	G0	x	x	x	262K-Colour (2-pixels/ 3byyes)	
		B5	B4	B3	B2	B1	B0	x	x	x	R5	R4	R3	R2	R1	R0	x	x	x		
		G5	G4	G3	G2	G1	G0	x	x	x	B5	B4	B3	B2	B1	B0	x	x	x		



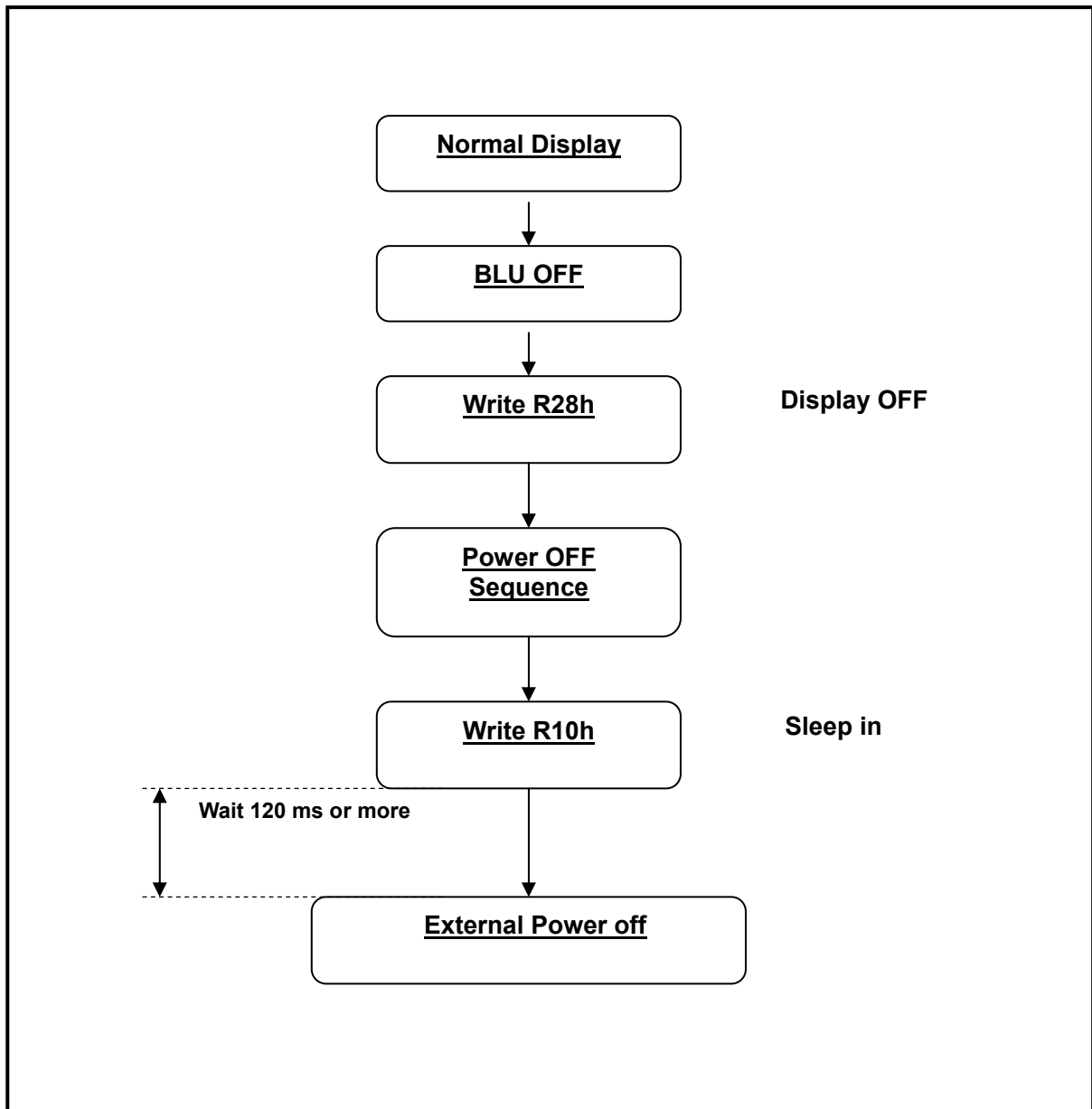
5.2 Power On/Off sequence

5.2.1 Power on Sequence





5.2.2 Power off Sequence





6 Optical characteristics

6.1 Optical Specification

Ta=25°C

Item	Symbol	Condition	Min	Typ.	Max.	Unit	Remark
View Angles	θT	$CR \geq 10$	35	40	-	Degree	Note 2
	θB		15	20	-		
	θL		40	45	-		
	θR		40	45	-		
Contrast Ratio	CR	$\theta = 0^\circ$	200	350	-		Note1 Note3
Response Time	Ton	25°C	-	25	40	ms	Note1
	Toff						Note4
Chromaticity	White	x	Brightness is on	0.26	0.30	0.36	Note5, Note1
		y		0.28	0.33	0.38	
	RED	x		0.55	0.60	0.65	
		y		0.27	0.32	0.37	
	GREEN	x		0.26	0.31	0.36	
		y		0.51	0.56	0.61	
	BLUE	x		0.10	0.15	0.20	
		y		0.03	0.08	0.13	
Uniformity	U		75	80	-	%	Note1 Note6
NTSC			-	60	-	%	Note 5
Luminance	L		150	200	-	cd/m ²	Note1 Note7

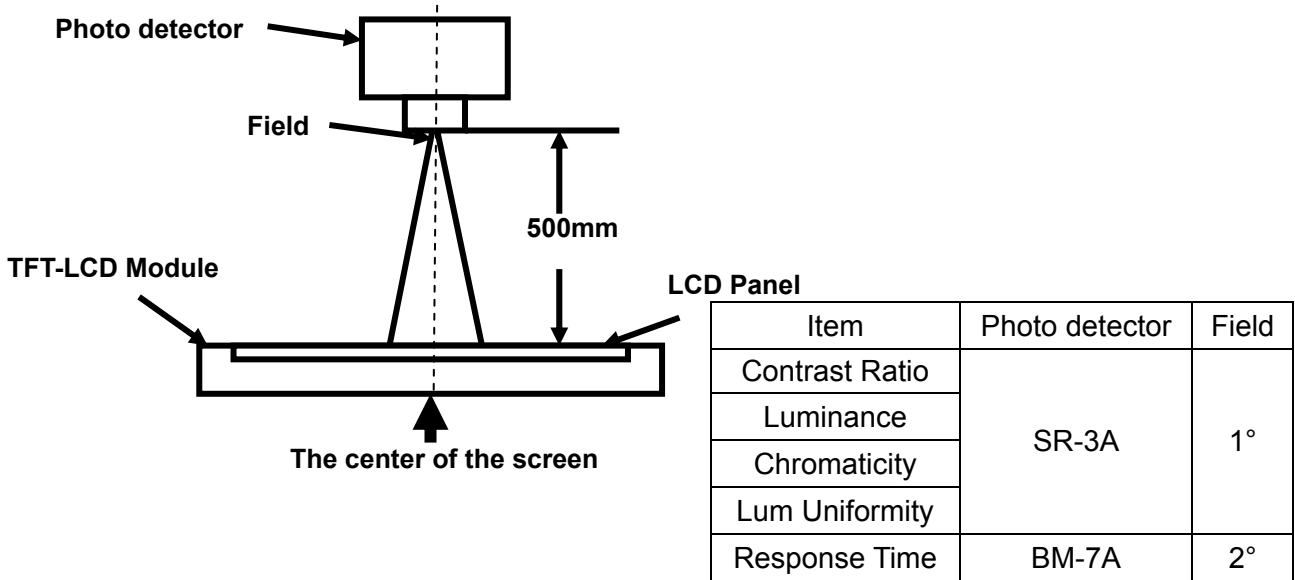
Test Conditions:

1. $V_{cc}=2.8V$, $I_L=20mA$ (Backlight current), the ambient temperature is 25°C.
2. The test systems refer to Note 1 and Note 2.



Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).

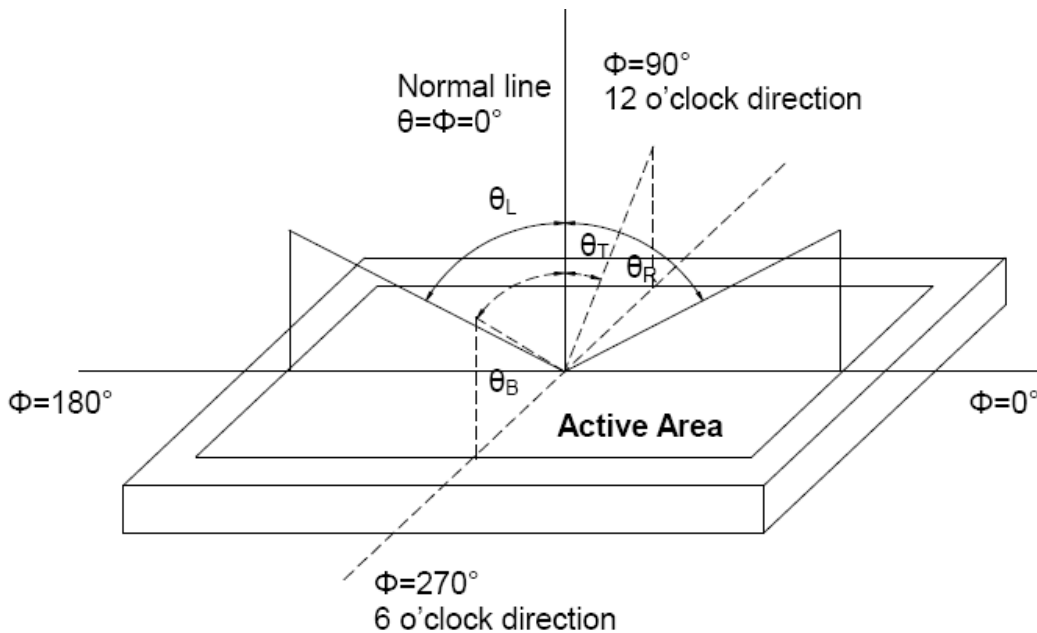


Fig. 1 Definition of viewing angle



Note 3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

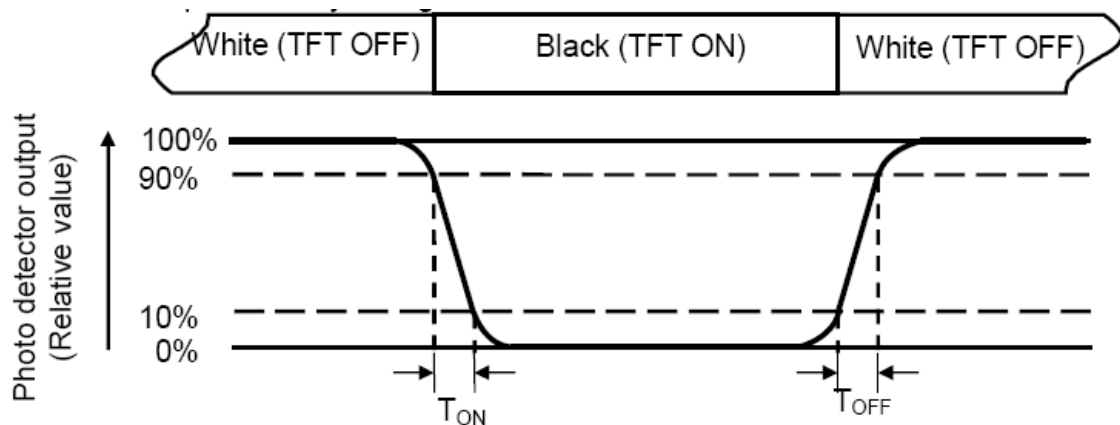
“White state “:The state is that the LCD should driven by V_{white} .

“Black state”: The state is that the LCD should driven by V_{black} .

V_{white} : To be determined V_{black} : To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.



Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

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

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

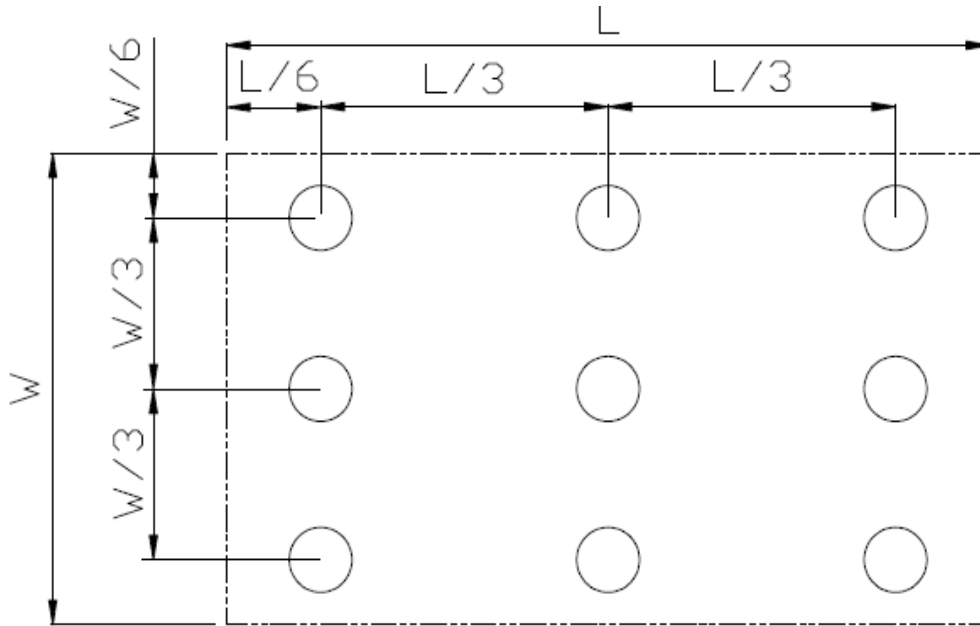


Fig. 2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.

Note 7: Definition of Luminance :

Measure the luminance of white state at center point.



7 Environmental / Reliability tests

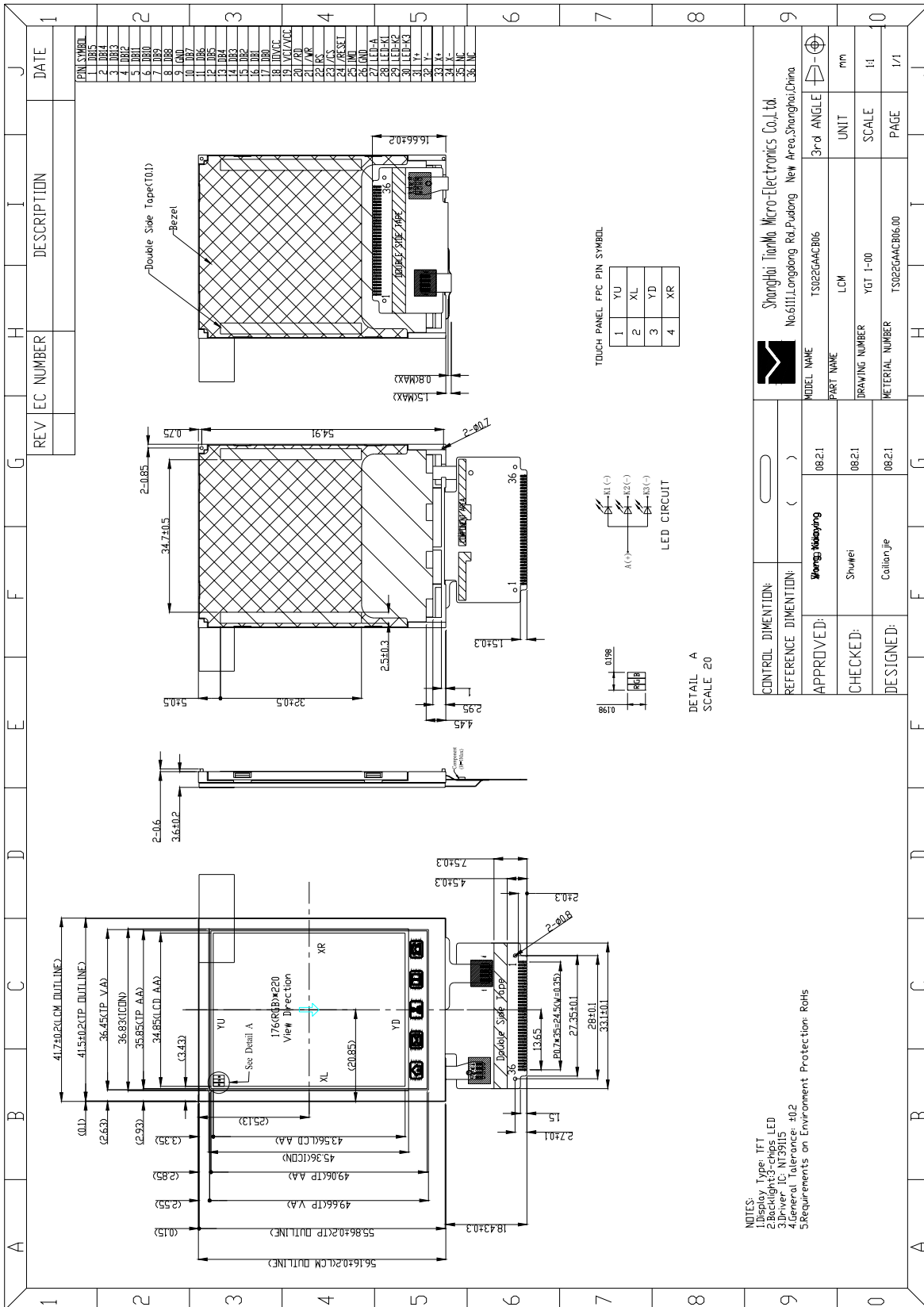
No	Test Item	Condition	Remarks
1	High Temperature (Operation)	Ts=+60℃, 240hrs	Note1 IEC60068-2-2,GB2423.2—89
2	High Temperature & High Humidity (Storage)	Ta=+60℃, 90% RH Max 240 hours	Note2 IEC60068-2-3, GB/T2423.3—2006
3	Low Temperature (Operation)	Ta=-20℃, 240hrs	IEC60068-2-1 GB2423.1—89
4	High Temperature (Storage)	Ta=+70℃, 240hrs	IEC60068-2-2, GB2423.2—89
5	Low Temperature (Storage)	Ta=-30℃, 240hrs	IEC60068-2-1 GB2423.1—89
6	Thermal Shock (Storage)	-30℃ 30 min~+70℃ 30 min, Change time:5min, 20 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22—87
7	Electro Static Discharge (Storage)	C=150pF, R=330Ω , 5points/panel Air:±8KV, 5times; Contact:±4KV, 5 times; (Environment: 15℃ ~ 35℃, 30% ~ 60%, 86Kpa ~ 106Kpa)	IEC61000-4-2 GB/T17626.2—1998
8	Vibration (Storage)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total)	IEC60068-2-6 GB/T2423.10—1995
9	Shock (Storage)	60G 6ms, ±X,±Y,±Z 3times, for each direction	IEC60068-2-27 GB/T2423.5—1995
10	Package Drop Test	Height:80 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8—1995

Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of samples.



8 Mechanical drawing



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9 Packing drawing

TBD



10 Precautions for use of LCD modules

10.1 Handling Precautions

- 10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 10.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
 - Isopropyl alcohol、
 - Ethyl alcohol
- 10.1.6 Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
 - Water
 - Ketone
 - Aromatic solvents
- 10.1.7 Do not attempt to disassemble the LCD Module.
- 10.1.8 If the logic circuit power is off, do not apply the input signals.
- 10.1.9 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
- 10.2 Be sure to ground the body when handling the LCD Modules.
- 10.3 Tools required for assembly, such as soldering irons, must be properly ground.
- 10.4 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
- 10.5 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.
- 10.6 Storage precautions
 - 10.6.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
 - 10.6.2 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:
- 10.7 Temperature : 0℃ ~ 40℃ Relatively humidity: ≤80%
 - 10.7.1 The LCD modules should be stored in the room without acid, alkali and harmful gas.
 - 10.7.2 Transportation Precautions
- 10.8 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.