SHANGHAI TIANMA MICRO-ELECTRONICS　　　TM022GDH09-00 V1.0

MODEL NO. :　__TM022GDH09-00__

ISSUED DATE:　__2010-11-30__

VERSION　　:　__Ver 1.0__

■Preliminary Specification
□Final Product Specification

Customer :_____

Approved by	Notes

SHANGHAI TIANMA Confirmed :

Prepared by	Checked by	Approved by

This technical specification is subjected to change without notice

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Record of Revision

Rev	Issued Date	Description	Editor
1.0	2010-11-30	Preliminary Specification Release	HuiWang

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1 General Specifications

Feature		Spec
Display Spec	Size	2.2 inch
	Resolution	176(RGB) x 220
	Interface	CPU 16 Bits
	Color Depth	262K/65K
	Technology Type	a-Si
	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)
	Viewing Direction	6 o'clock
	Gray Scale Inversion Direction	12 o'clock
Mechanical Characteristics	LCM (W x H x D) (mm)	39.90x54.00x2.24
	Active Area(mm)	34.848×43.560
	With /Without TSP	Without TSP
	Weight (g)	TBD
	LED Numbers	4 LEDs
Electronic	Driver IC	S6D0164

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

Note 3: LCM weight tolerance: +/- 0.5%

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2　Input/Output Terminals

2.1　TFT LCD Panel

No	Symbol	I/O	Description	Remark
1	GND	P	Ground	
2	IM0	I	8/16 select IM0=1:8bit IM0=0:16bit	
3	VDD3	P	Logic Supply	
4	TE	O	Tearing Effect	
5	DB0	I	CPU Data Bus B0	
6	DB1	I	CPU Data Bus B1	
7	DB2	I	CPU Data Bus B2	
8	DB3	I	CPU Data Bus B3	
9	DB4	I	CPU Data Bus B4	
10	DB5	I	CPU Data Bus B5	
11	DB6	I	CPU Data Bus B6	
12	DB7	I	CPU Data Bus B7	
13	DB8	I	CPU Data Bus B8	
14	DB9	I	CPU Data Bus B9	
15	DB10	I	CPU Data Bus B10	
16	DB11	I	CPU Data Bus B11	
17	DB12	I	CPU Data Bus B12	
18	DB13	I	CPU Data Bus B13	
19	DB14	I	CPU Data Bus B14	
20	DB15	I	CPU Data Bus B15	
21	GND	P	Ground	
22	GND	P	Ground	
23	WRB	I	Write Strobe	
24	RDB	I	Read Strobe	
25	RESET	I	Reset Signal	
26	CSB	I	Chip Select	
27	RS	I	Register Select	
28	VCI	P	DC/DC Supply	
29	GND	P	Ground	
30	LED_A	P	LED Backlight Anode	
31	LED_C	P	LED Backlight Cathode	
32	LED_C	P	LED Backlight Cathode	
33	LED_C	P	LED Backlight Cathode	
34	LED_C	P	LED Backlight Cathode	
35	GND	P	Ground	

Note: I/O definition:

　　　I----Input　　O----Output　　P----Power/Ground

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3　Absolute Maximum Ratings

3.1　Driving TFT LCD Panel

Ta=25°C

Item	Symbol	Min	Max	Unit	Remark
Logic Supply Voltage	VDD3	-0.3	5.0	V	
Analog Supply Voltage	VCI	-0.3	5.0	V	
Input Voltage	CSB,RS,WRB,RDB, RESET,DB[0:15]	-0.3	VDD3 +0.5	V	
Back Light Forward Current	I_{LED}	--	18	mA	
Operating Temperature	T_{OPR}	-20	70	℃	
Storage Temperature	T_{STG}	-30	80	℃	

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4 Electrical Characteristics

4.1 Driving TFT LCD Panel

GND=0V, Ta=25℃

Item		Symbol	Min	Typ	Max	Unit	Remark
Logic Supply Voltage		VDD3	1.65	1.80	2.0	V	
Analog Supply Voltage		VCI	2.5	2.6	3.0	V	
Input Signal Voltage	Low Level	V_{IL}	0	--	0.2xVDD3	V	CSB,RS,WRB,RDB, RESET,DB[0:15]
	High Level	V_{IH}	0.8x VDD3	--	VDD3	V	
Output Signal Voltage	Low Level	V_{OL}	-0.3	--	0.2xVDD3	V	TE
	High Level	V_{OH}	0.8xVDD3	--	VDD3	V	
(Panel+LSI) Power Consumption	Black Mode		TBD.	TBD.	TBD.	mW	
	8 color Mode		TBD.	TBD.	TBD.	mW	
	Deep-standby Mode		TBD.	TBD.	TBD.	mW	

4.2 Driving Backlight

Ta=25℃

Item	Symbol	Min	Typ	Max	Unit	Unit
Forward Current	I_F	-	-	18	mA	For each LED
Forward Voltage	V_F	-	-	3.18	V	4LEDs (in parallel)
Power Consumption	W_{BL}	-	-	228.96	mW	

Note1:　Figure below shows the connection of backlight LED.
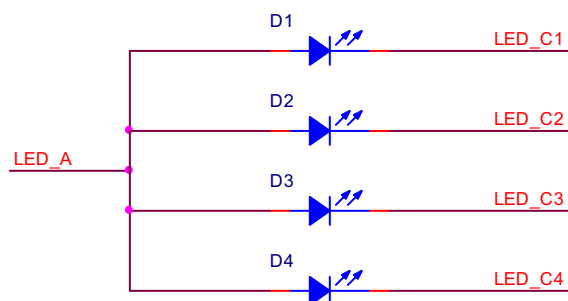
Note 2: One LED : I_F =18 mA, V_F =3.18V

Note 3: The Minimum life of LED : 20,000 hours

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4.3　Block Diagram


```
LCD PANEL

2.2 inch
176 (RGB) X220

RAM

VCOM&
TCON                RESET          RESET

                    DB [0:15]      Data Bus

Source+ Gate
Driver

                    CSB, RS,       CPU I/F
DC/DC
                    RDB, WRB

Grayscale                          FPC
Manipulation        TE             TE
Voltage

LCD Driver Chip (COG)

                    VCI, VDD3, GND  POWER

BLU     LED_A, LED_C, LED_C, LED_C, LED_C    BLU
```
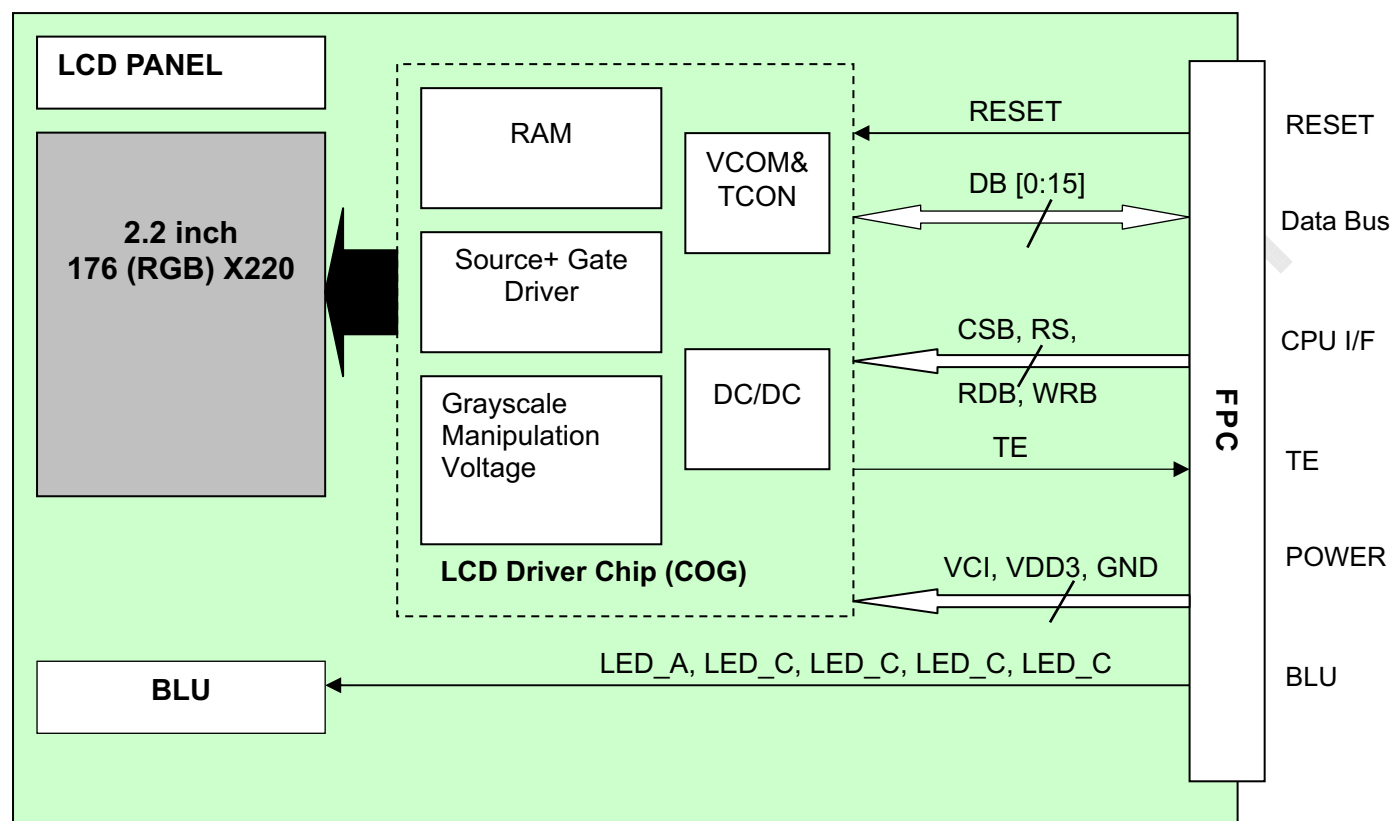
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5 Timing Chart

5.1 Timing Parameter

Characteristic		Symbol	Specification		Unit
			Min.	Max.	
Cycle time	Write	tCYCW80	100	-	
	Read	tCYCR80	500	-	
Pulse rise / fall time		tR, tF	-	15	
Pulse width low	Write	tWLW80	33	-	
	Read	tWLR80	250	-	
Pulse width high	Write	tWHW80	33	-	ns
	Read	tWHR80	250	-	
RS to CSB, WRB(RDB) setup time		tAS80	10	-	
RS to CSB, WRB(RDB) hold time		tAH80	2	-	
CSB to WRB(RDB) time		tCW80	15	-	
Write data setup time		tWDS80	20	-	
Write data hold time		tWDH80	10	-	
Read data delay time		tRDD80	-	200	
Read data hold time		tRDH80	10	-	

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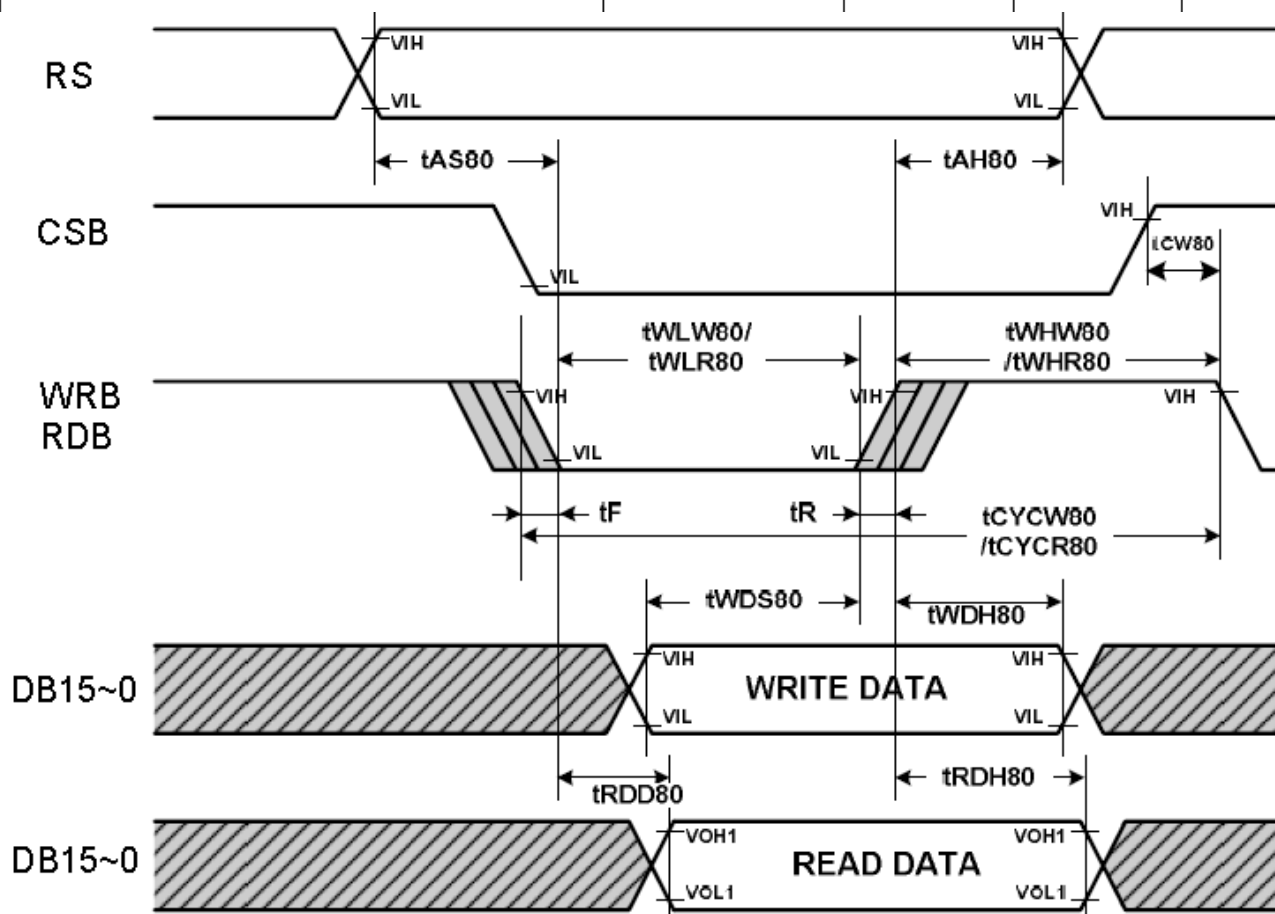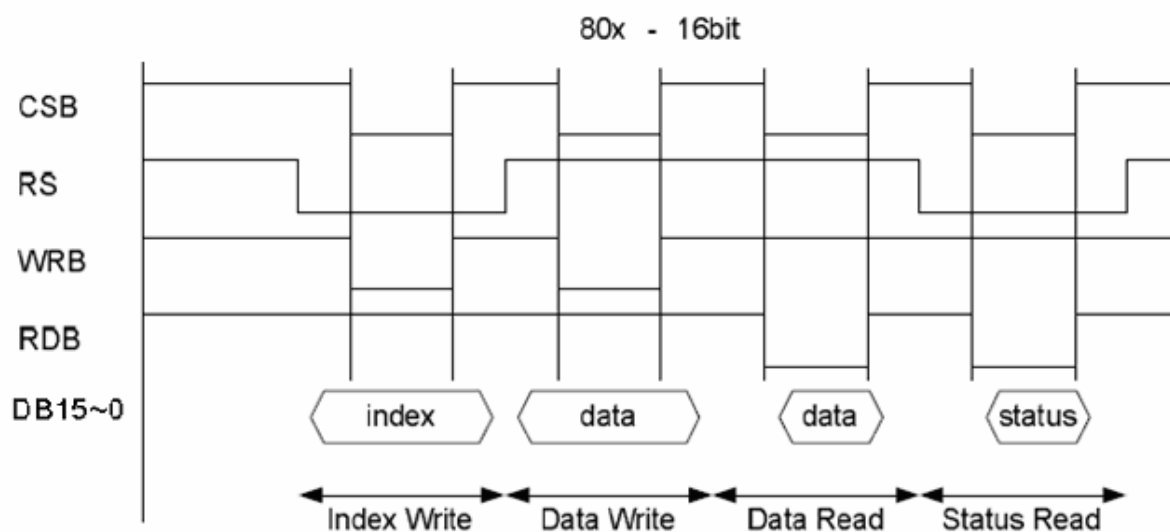
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5.2 Signals Timing Chart

5.3 Reset Input Timing

Parameter	Description	Min	Max	Unit
tRES	Reset low pulse width	10	-	us

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5.4 Data Format

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5.5   Power On/Off sequence

5.5.1 Power on Sequence
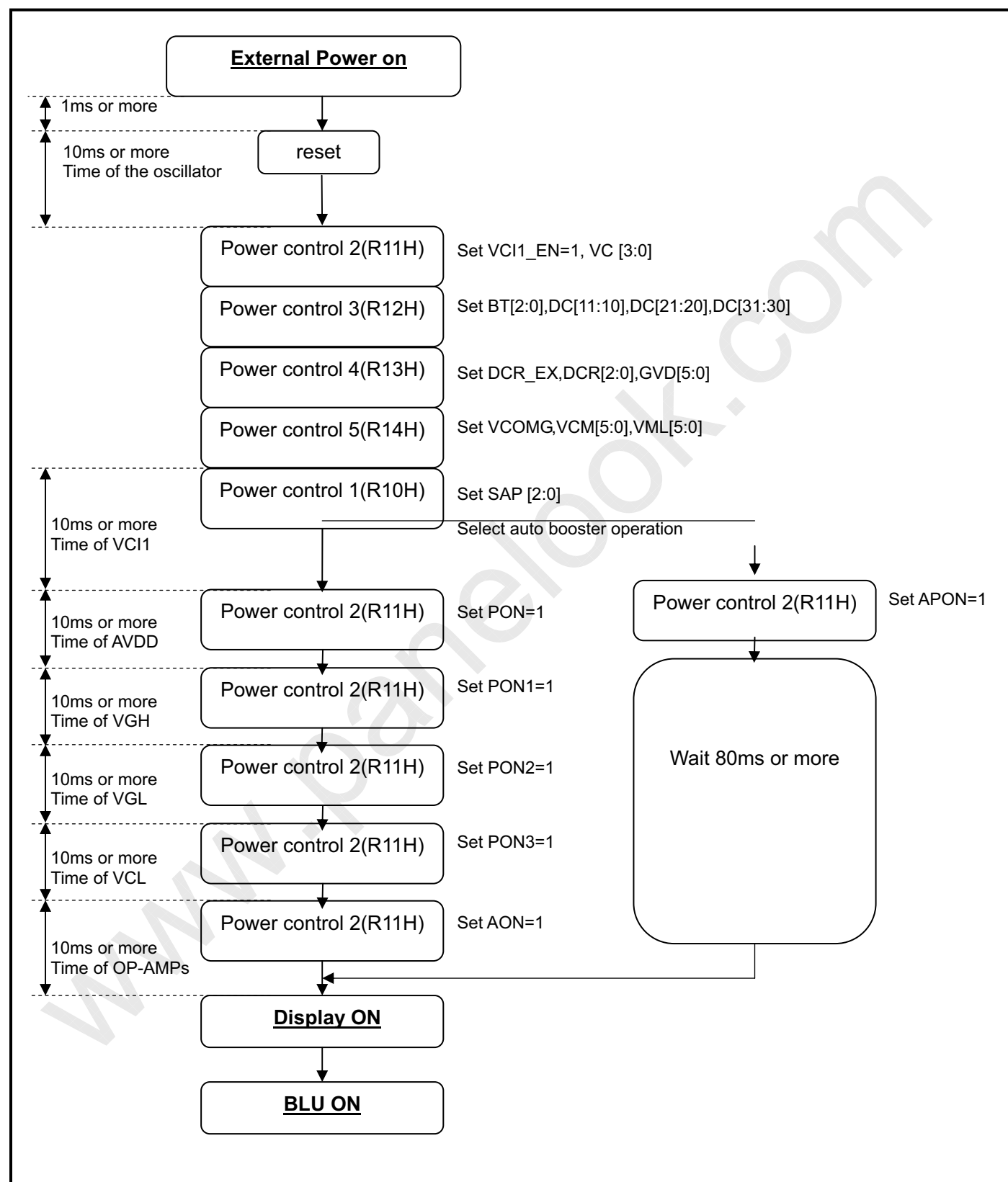
```
                        ┌─────────────────────────┐
                        │   External Power on     │
                        └─────────────────────────┘
   1ms or more                      │
                        ┌─────────────────────────┐
   10ms or more         │         reset           │
   Time of the oscillator └───────────────────────┘
                                    │
                        ┌─────────────────────────┐
                        │ Power control 2(R11H)   │  Set VCI1_EN=1, VC [3:0]
                        └─────────────────────────┘
                        ┌─────────────────────────┐
                        │ Power control 3(R12H)   │  Set BT[2:0],DC[11:10],DC[21:20],DC[31:30]
                        └─────────────────────────┘
                        ┌─────────────────────────┐
                        │ Power control 4(R13H)   │  Set DCR_EX,DCR[2:0],GVD[5:0]
                        └─────────────────────────┘
                        ┌─────────────────────────┐
                        │ Power control 5(R14H)   │  Set VCOMG,VCM[5:0],VML[5:0]
                        └─────────────────────────┘
                        ┌─────────────────────────┐
   10ms or more         │ Power control 1(R10H)   │  Set SAP [2:0]
   Time of VCI1         └─────────────────────────┘
                                                      Select auto booster operation
                        ┌─────────────────────────┐              ┌─────────────────────────┐
   10ms or more         │ Power control 2(R11H)   │  Set PON=1   │ Power control 2(R11H)   │  Set APON=1
   Time of AVDD         └─────────────────────────┘              └─────────────────────────┘
                        ┌─────────────────────────┐              ┌─────────────────────────┐
   10ms or more         │ Power control 2(R11H)   │  Set PON1=1  │                         │
   Time of VGH          └─────────────────────────┘              │                         │
                        ┌─────────────────────────┐              │                         │
   10ms or more         │ Power control 2(R11H)   │  Set PON2=1  │   Wait 80ms or more     │
   Time of VGL          └─────────────────────────┘              │                         │
                        ┌─────────────────────────┐              │                         │
   10ms or more         │ Power control 2(R11H)   │  Set PON3=1  │                         │
   Time of VCL          └─────────────────────────┘              │                         │
                        ┌─────────────────────────┐              │                         │
   10ms or more         │ Power control 2(R11H)   │  Set AON=1   └─────────────────────────┘
   Time of OP-AMPs      └─────────────────────────┘
                        ┌─────────────────────────┐
                        │      Display ON         │
                        └─────────────────────────┘
                        ┌─────────────────────────┐
                        │       BLU ON            │
                        └─────────────────────────┘
```

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5.4.2 Power off Sequence

```
         ┌─────────────────────┐
         │   Normal Display    │
         └─────────────────────┘
                    │
                    ▼
         ┌─────────────────────┐
         │      BLU OFF        │
         └─────────────────────┘
                    │
                    ▼
         ┌─────────────────────┐
         │    Display OFF      │
         │     Sequence        │
         └─────────────────────┘
                    │
                    ▼
         ┌─────────────────────┐
         │ Power control 1(R10H)│    Set STD=1
         └─────────────────────┘
     Wait 20 ms or more
                    │
                    ▼
         ┌─────────────────────┐
         │  External Power off  │
         └─────────────────────┘
```

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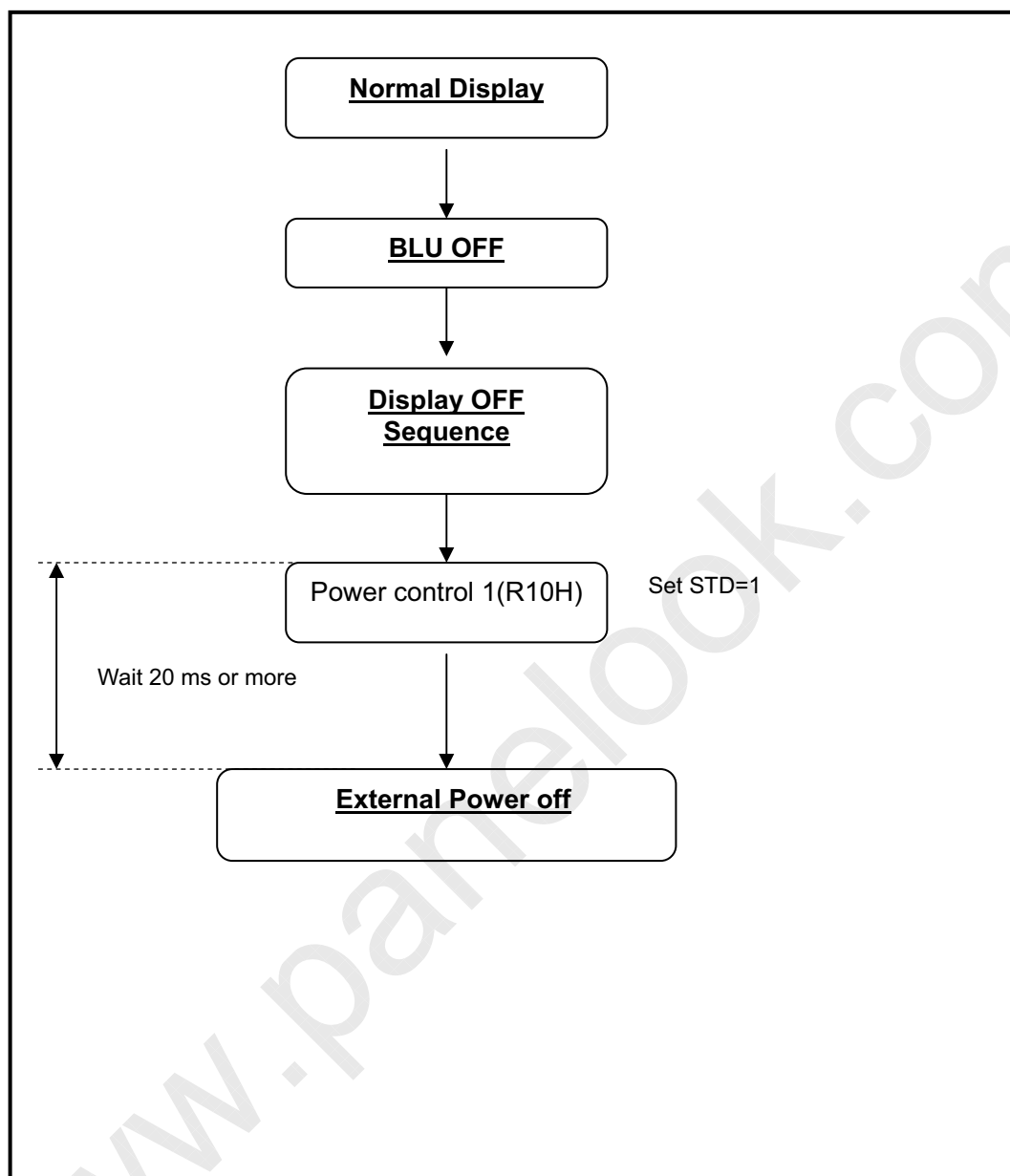
6 Optical Characteristics

6.1 Optical Specification

Ta=25℃

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	25	30	-	Degree	Note 2
		θB		20	30	-		
		θL		35	40	-		
		θR		35	40	-		
Contrast Ratio		CR	θ=0°	300	450	-	--	Note1 Note3
Response Time		T_{ON}	25℃	--	12.5	17.5	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	S(u',v')	Backlight is on	--	208.24	--	--	Note5 Note1
		huv		--	2.72	--		
	Red	S(u',v')		--	14.31	--		
		huv		--	1.35	--		
	Green	S(u',v')		--	120.10	--		
		huv		--	3.35	--		
	Blue	S(u',v')		--	260.48	--		
		huv		--	208.24	--		
Uniformity		U	--	71.4	77	-	%	Note1 Note6
NTSC		--	--	-	52	-	%	Note 5
Luminance		L	--	360	450	-	cd/m²	Note1 Note7

Test Conditions:

1. V_F =3.18V, I_F =18mA(LED current), the ambient temperature is 25℃.

2. The test systems refer to Note 1 and Note 2.

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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.

Photo detector

Field

500mm

TFT-LCD Module

LCD Panel

The center of the screen

Item	Photo detector	Field
Contrast Ratio	SR-3A	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°
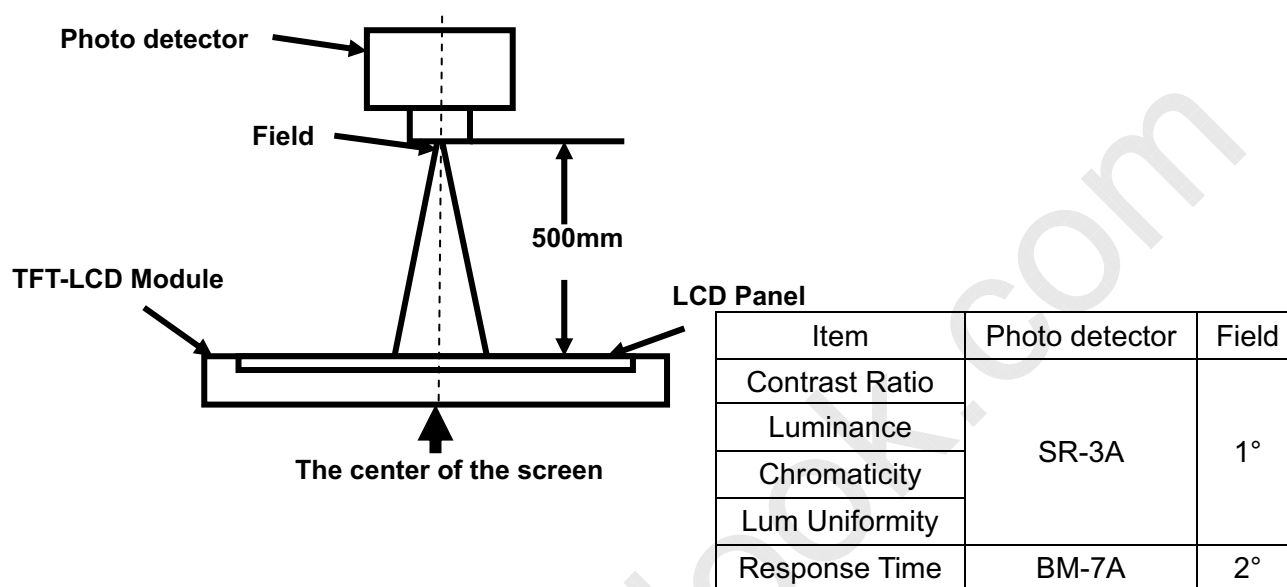
Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80)。
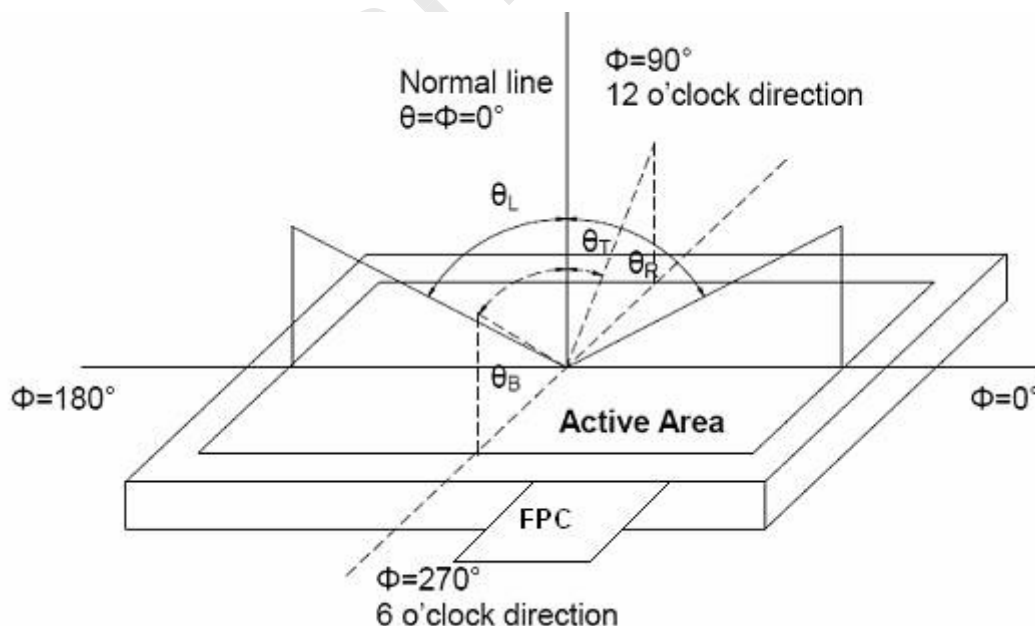
Fig. 1 Definition of viewing angle

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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 Vwhite.

"Black state": The state is that the LCD should driven by Vblack.

Vwhite: To be determined   Vblack: 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 (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from 10% to 90%.
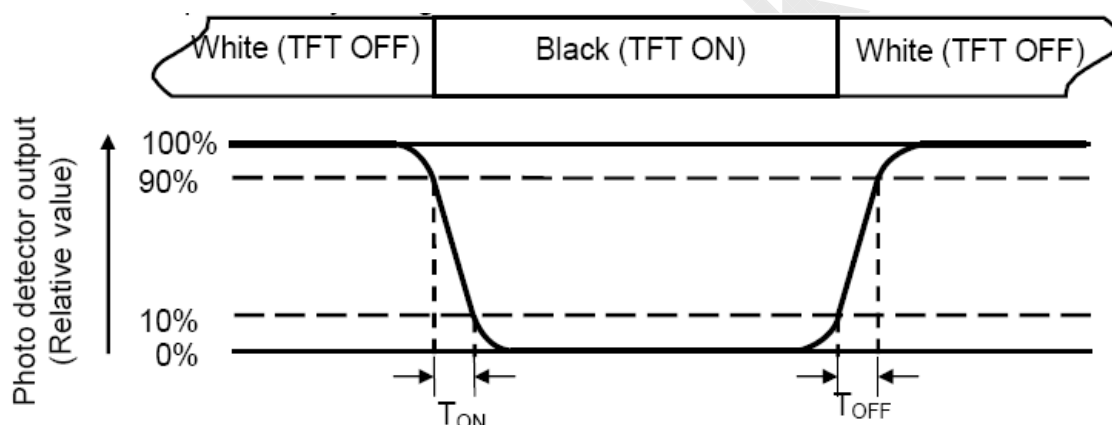
Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

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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.

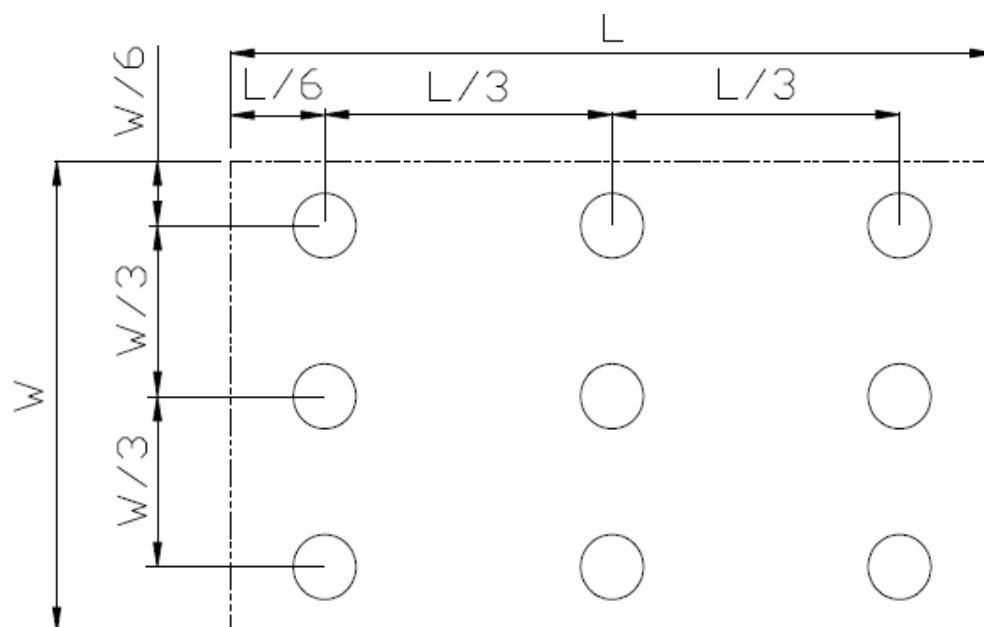Luminance Uniformity(U) = Lmin/ Lmax

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.

s

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7 Environmental / Reliability Tests

No	Test Item	Condition	Remark
1	High Temperature Operation	Ts=+70℃, 240hrs	Note1 IEC60068-2-2,GB2423.2—89
2	Low Temperature Operation	Ta=-20℃, 240hrs	IEC60068-2-1 GB2423.1—89
3	High Temperature Storage	Ta=+85℃, 240hrs	IEC60068-2-2, GB2423.2—89
4	Low Temperature Storage	Ta=-30℃, 240hrs	IEC60068-2-1 GB2423.1—89
5	High Temperature & High Humidity Storage	Ta=+60℃, 90% RH 240 hours	Note2 IEC60068-2-3, GB/T2423.3—2006
6	Thermal Shock (Non-operation)	-30℃ 30 min~+80℃ 30 min, Change time:5min, 50 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22—87
7	Electro Static Discharge (Operation)	Human body mode: C=100pF, R=1500Ω, Contact:±5.5KV,5times;15points/panel Air:± 5.5KV, 5 times;11points/panel （Environment: 15℃～35℃, 30%～60%, 86Kpa～106Kpa）	IEC61000-4-2 GB/T17626.2—1998
8	Vibration (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)	IEC60068-2-6 GB/T2423.10—1995
9	Shock (Non-operation)	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
11	EMI Test	Follow Motorola's request	Refer to RA test plan
12	Four-point bending test	Follow Motorola's request	Refer to RA test plan

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

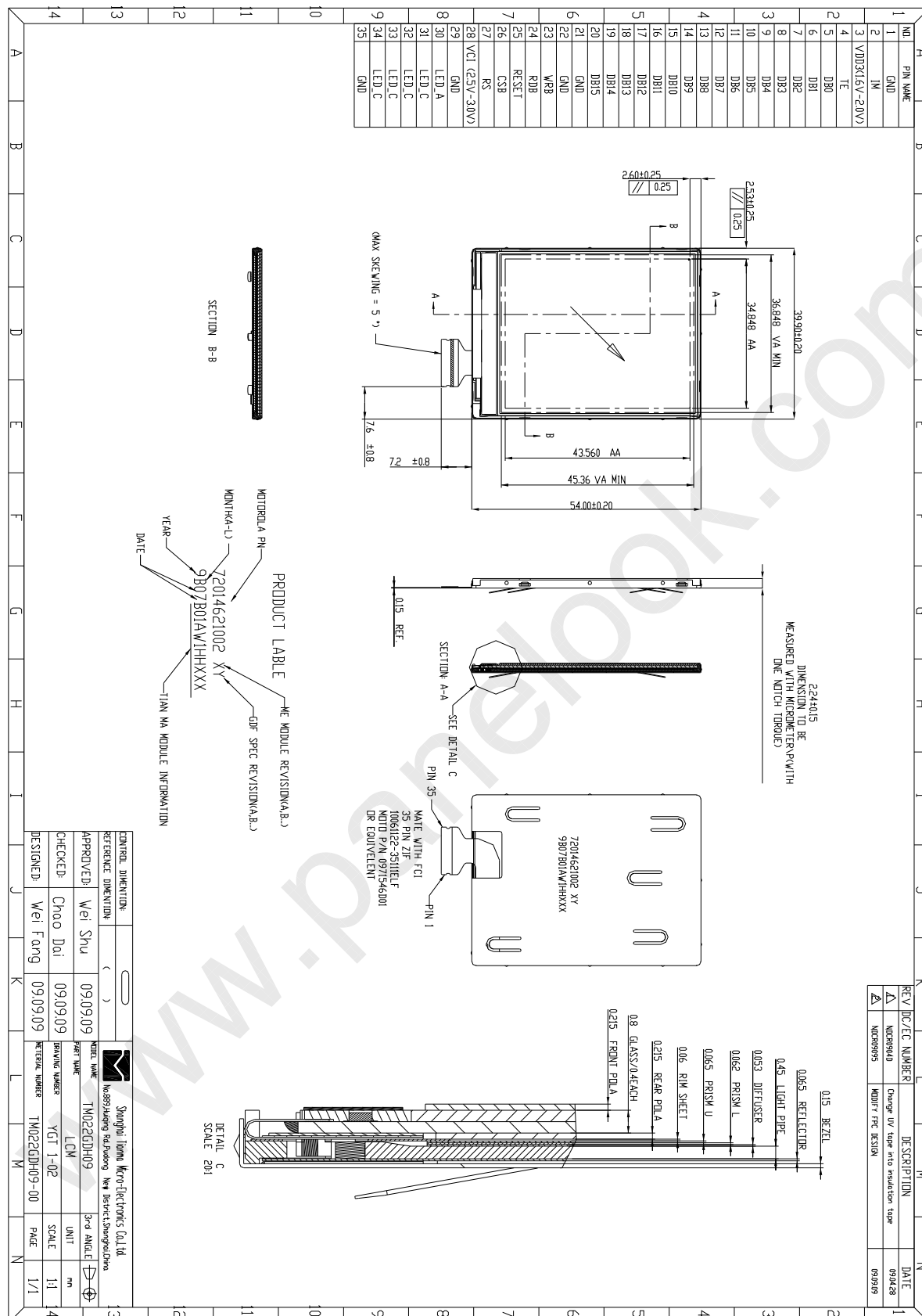Note2: Ta is the ambient temperature of samples.

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8 Mechanical Drawing

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9 Packing Drawing

TBD

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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

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

－ Water

－ Ketone

－ Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

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

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

10.1.8.1 Be sure to ground the body when handling the LCD Modules.

10.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

10.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

10.1.8.4 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.

10.2 Storage precautions

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

10.2.2 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%

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

10.3 Transportation Precautions

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