

MODEL NO. : TM028HDH11ISSUED DATE: 2009-02-24VERSION : Ver 1.1☒ Preliminary Specification☐ Final Product Specification

Customer : \_\_\_\_\_

Approved by	Notes

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Prepared by	Checked by	Approved by

This technical specification is subjected to change without notice.



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## Record of Revision

Rev	Issue Date	Description	Editor
1.0	2008-11-25	Preliminary release.	Qiuping Yang
1.1	2009-02-24	Update contrast ratio and viewing angle	Robin Wang



## 1 General Specifications

Feature		Spec
Display Spec	Size	2.83 inch
	Resolution	240(RGB) x 320
	Interface	CPU 16 bits
	Color Depth	65K
	Technology Type	a-Si
	Pixel Pitch (mm)	0.180 x 0.180
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	TM with Normally White
	Surface Treatment	Clear type (3H)
	Viewing Direction	6 o'clock
	Gray Scale Inversion Direction	12 o'clock
Mechanical Characteristics	LCM (W x H x D) (mm)	50.00x69.20x3.05
	Active Area(mm)	43.20 x 57.60
	With /Without TSP	Without TSP
	Weight (g)	TBD
	LED Numbers	4 LEDs
Electronic	Driver IC	NT39116

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: +/- 5%.



## 2 Input/Output Terminals

### 2.1 TFT LCD Panel

No	Symbol	I/O	Description	Remark
1	LEDK4	P	LED light cathode	
2	LEDK3	P	LED light cathode	
3	LEDK2	P	LED light cathode	
4	LEDK1	P	LED light cathode	
5	LEDA	P	LED light anode	
6	GND	P	Ground	
7	GND	P	Ground	
8	/RESET	I	Reset signal	
9	GND	P	Ground	
10	DB15	I	Data input	
11	DB14	I	Data input	
12	DB13	I	Data input	
13	DB12	I	Data input	
14	DB11	I	Data input	
15	DB10	I	Data input	
16	DB9	I	Data input	
17	DB8	I	Data input	
18	NC	--	Not Connect	
19	DB7	I	Data input	
20	DB6	I	Data input	
21	DB5	I	Data input	
22	DB4	I	Data input	
23	DB3	I	Data input	
24	DB2	I	Data input	
25	DB1	I	Data input	
26	DB0	I	Data input	
27	NC	--	Not Connect	
28	/RD	I	Read signal	
29	/WR	I	Write signal	
30	RS	I	Command / data select pin	
31	/CS	I	Chip selection	
32	FMARK	O	Frame head pulse signal, which is used when	
33	VCC	P	I/O power supply for LCD driver	
34	NC	--	Not Connect	
35	VCI	P	Analog Power supply for LCD driver	
36	GND	P	Ground	
37	X(R)	--	Not Connect	
38	Y(D)	--	Not Connect	
39	X(L)	--	Not Connect	
40	Y(U)	--	Not Connect	

Note: I/O definition: I-----Input; O---Output; P----Power/Ground.



### 3 Absolute Maximum Ratings

#### 3.1 Driving TFT LCD Panel

GND=0V, Ta=25°C

Item	Symbol	Min	Max	Unit	Remark
Logic Supply Voltage	VCC	-0.3	4.6	V	
Analog Supply Voltage	VCI	-0.3	4.6	V	
Input Signal Voltage	DB0~DB15,/CS,RS,/WR,/RD, /RESET	-0.3	VCC+ 0.3	V	
Back Light Forward Current	I <sub>LED</sub>	--	25.0	mA	For each LED
Operating Temperature	T <sub>OPR</sub>	-20	70	°C	
Storage Temperature	T <sub>STG</sub>	-30	80	°C	



## 4 Electrical Characteristics

### 4.1 Driving TFT LCD Panel

GND=0V, Ta=25°C

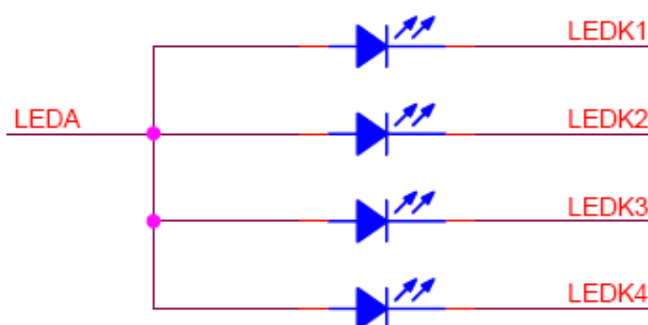
Item		Symbol	Min	Typ	Max	Unit	Remark
Logic Supply Voltage		VCC	1.65	2.8	3.3	V	
Analog Supply Voltage		VCI	2.5	2.8	3.3	V	
Input Signal Voltage	Low Level	V <sub>IL</sub>	0	--	0.2xVCC	V	DB0~DB15,/CS,RS, /WR,/RD,/RESET
	High Level	V <sub>IH</sub>	0.8xVCC	--	VCC	V	
Output Signal Voltage	Low Level	V <sub>OL</sub>	0	--	0.2xVCC	V	FMARK
	High Level	V <sub>OH</sub>	0.8xVCC	--	VCC	V	
(Panel+ LSI) Power Consumption		Black Mode	--	20	--	mW	Frame Rate:60Hz
		Standby Mode	--	100	--	μW	
		Sleeping Mode	--	200	--	μW	

### 4.2 Driving Backlight

Ta=25°C

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I <sub>F</sub>	--	20	--	mA	For each LED
Forward Voltage	V <sub>F</sub>	--	3.2	--	V	For each LED
Power Consumption	W <sub>BL</sub>	--	256	--	mW	

Note 1: The figure below shows the connection of backlight LED.

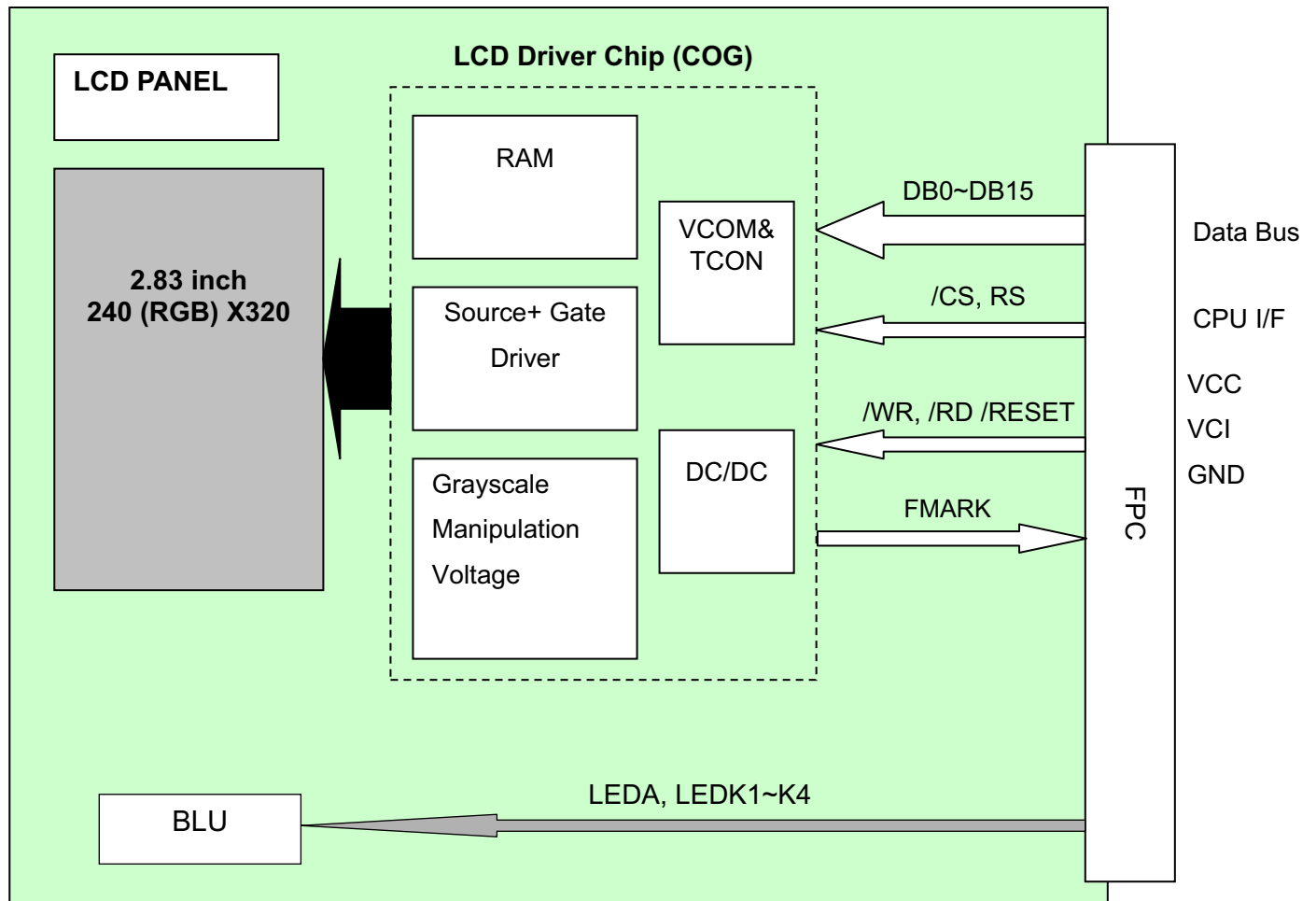


Note 2: One LED: I<sub>F</sub> =20mA, V<sub>F</sub> =3.2V.

Note 3: The life of LED: 20,000 hrs.



## 4.3 Block Diagram







## 5 Timing Chart

### 5.1 Timing Parameter

Signal	Symbol	Parameter	Min	Max	Unit	Description
RS	$t_{AST}$	Address setup time	0		ns	--
	$t_{AHT}$	Address hold time (Write/Read)	10		ns	
/CS	$t_{CHW}$	Chip select "H" pulse width	0		ns	3-transfer for one pixel
	$t_{CS}$	Chip select setup time (Write)	15		ns	
	$t_{RCS}$	Chip select setup time (Read ID)	45		ns	
	$t_{RCSFW}$	Chip select setup time (Read FM)	355		ns	
	$t_{CSF}$	Chip select wait time (Write/Read)	10		ns	
	$t_{CSH}$	Chip select hold time	10		ns	
/WR	$t_{WC}$	Write cycle	65		ns	
	$t_{WRH}$	Control pulse "H" duration	15		ns	
	$t_{WRL}$	Control pulse "L" duration	15		ns	
/RD (ID)	$t_{RC}$	Read cycle (ID)	160		ns	When read ID data
	$t_{RDH}$	Control pulse "H" duration (ID)	90		ns	
	$t_{RDL}$	Control pulse "L" duration (ID)	45		ns	
/RD (FM)	$t_{RCFM}$	Read cycle (FM)	450		ns	When read from frame Memory
	$t_{RDHFM}$	Control pulse "H" duration (FM)	90		ns	
	$t_{RDLFM}$	Control pulse "L" duration (FM)	355		ns	
DB[15:0]	$t_{DST}$	Data setup time	10		ns	For maximum $C_L=30pF$ For Minimum $C_L=8pF$
	$t_{DHT}$	Data hold time	10		ns	
	$t_{RAT}$	Read access time (ID)		40	ns	
	$t_{RATFM}$	Read access time (FM)		340	ns	
	$t_{ODT}$	Output disable time	20	80	ns	

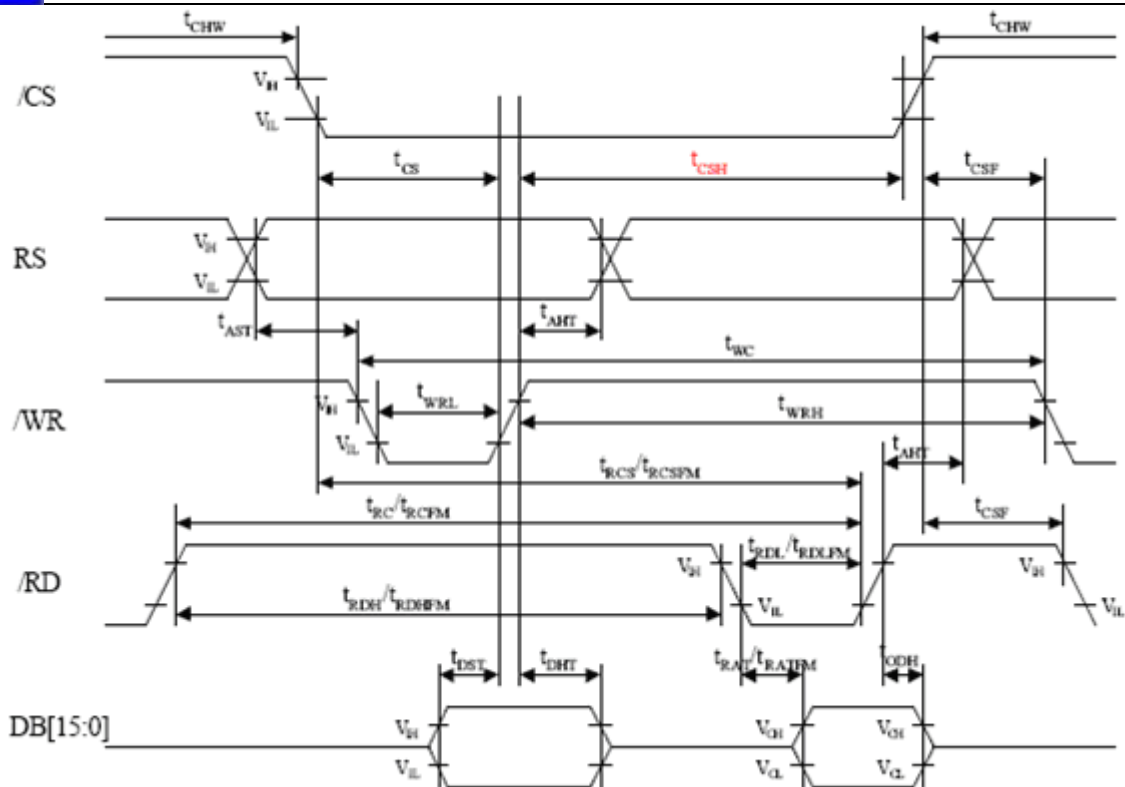


Figure 5.1 i80 System Bus Timing

## Reset Timing Characteristics

Ta=25°C

Item	Symbol	Unit	Min	Typ	Max
Reset low-level width	$t_{RES}$	ms	1	--	--
Reset rise time	$t_{rRES}$	$\mu s$	--	--	10

Table RESET Timing Parameter





## 5.2 Register write timing

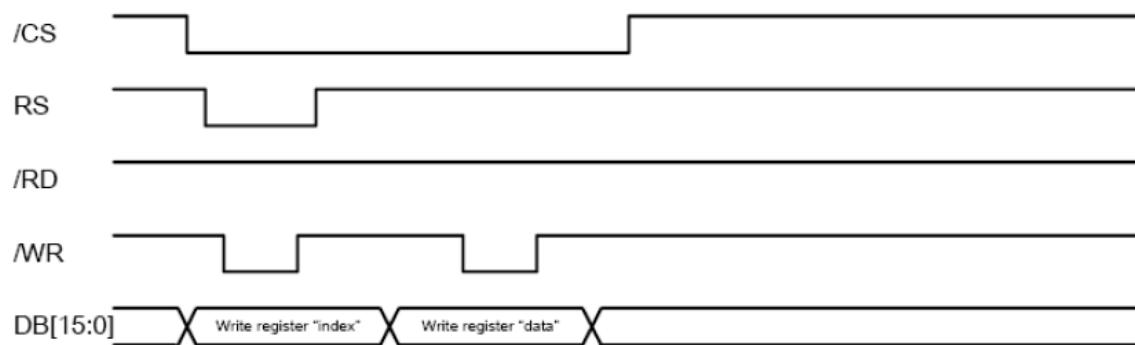


Figure 5.2.1 i80 16-bit System Bus Interface Timing(Register Write Timing)



### 5.3 GRAM Write Timing

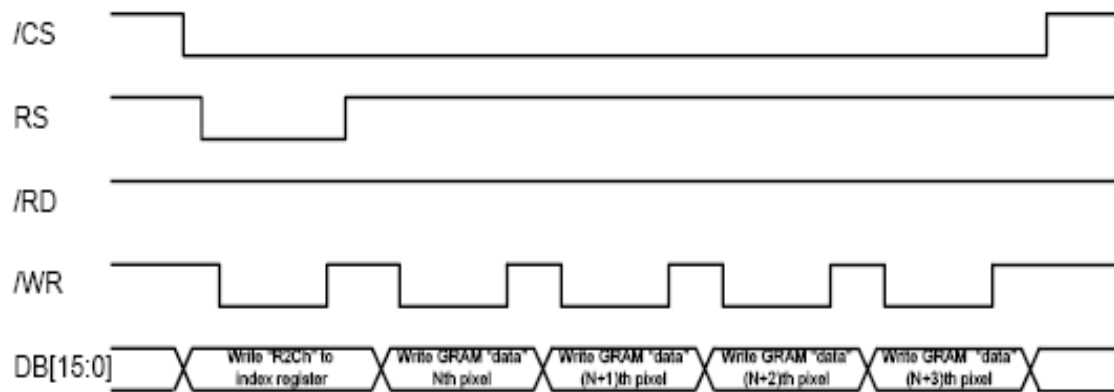


Figure 5.3.1 i80 16-bit System Bus Interface Timing (GRAM Write Timing)

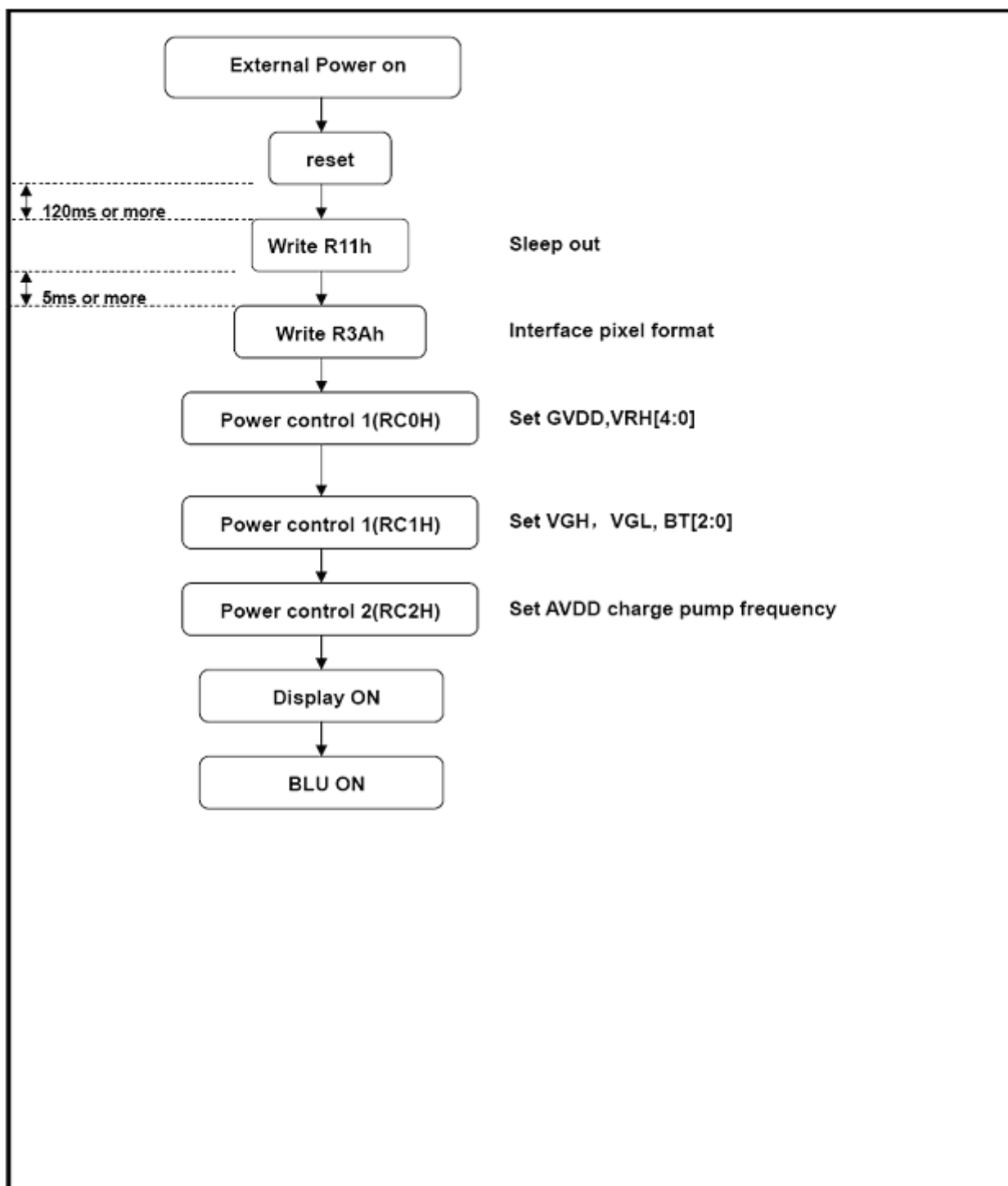
Register Command	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	Register
2Ch	x	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0	2Ch
3AH	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	Color
05h	x	x	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	65K-Color
06h	x	x	R5	R4	R3	R2	R1	R0	x	x	G5	G4	G3	G2	G1	G0	x	x	262K-Color (1-pixels/ 3bytes)
	x	x	B5	B4	B3	B2	B1	B0	x	x	R5	R4	R3	R2	R1	R0	x	x	
	x	x	G5	G4	G3	G2	G1	G0	x	x	B5	B4	B3	B2	B1	B0	x	x	

Figure 5.3.2 i80-System Interface with 16-bit Data Bus



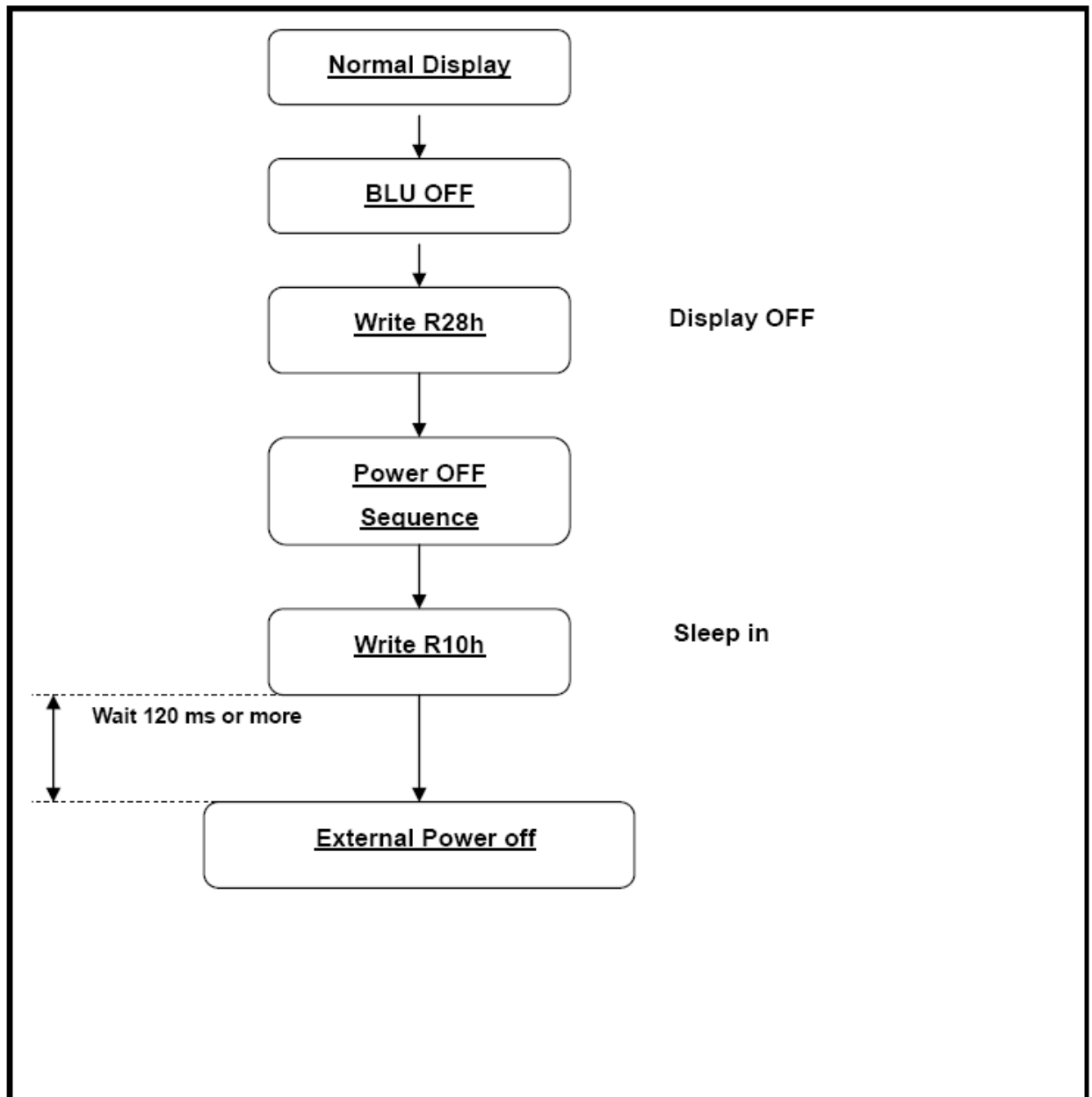
## 5.4 Power ON/OFF Sequence

### 5.4.1 Power ON Sequence





## 5.4.2 Power OFF Sequence





## 6 Optical Characteristics

### 6.1 Optical Specification

Ta=25℃

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angle		θT	CR≧10	50	75	--	Degree	Note 2
		θB		30	55	--		
		θL		50	75	--		
		θR		50	75	--		
Contrast Ratio		CR	θ=0°	350	500	--		Note1 Note3
Response Time		T <sub>ON</sub>	25℃	--	25	40	ms	Note1
		T <sub>OFF</sub>						Note4
Chromaticity	White	x	Backlight is on	0.260	0.310	0.360		Note1 Note5
		y		0.280	0.330	0.380		
	Red	x		0.564	0.614	0.664		
		y		0.321	0.371	0.421		
	Green	x		0.284	0.334	0.384		
		y		0.547	0.597	0.647		
	Blue	x		0.091	0.141	0.191		
		y		0.060	0.110	0.160		
Uniformity		U		75	80	--	%	Note1 Note6
NTSC				--	55	--	%	Note5
Luminance		L		225	275	--	cd/m <sup>2</sup>	Note1 Note7

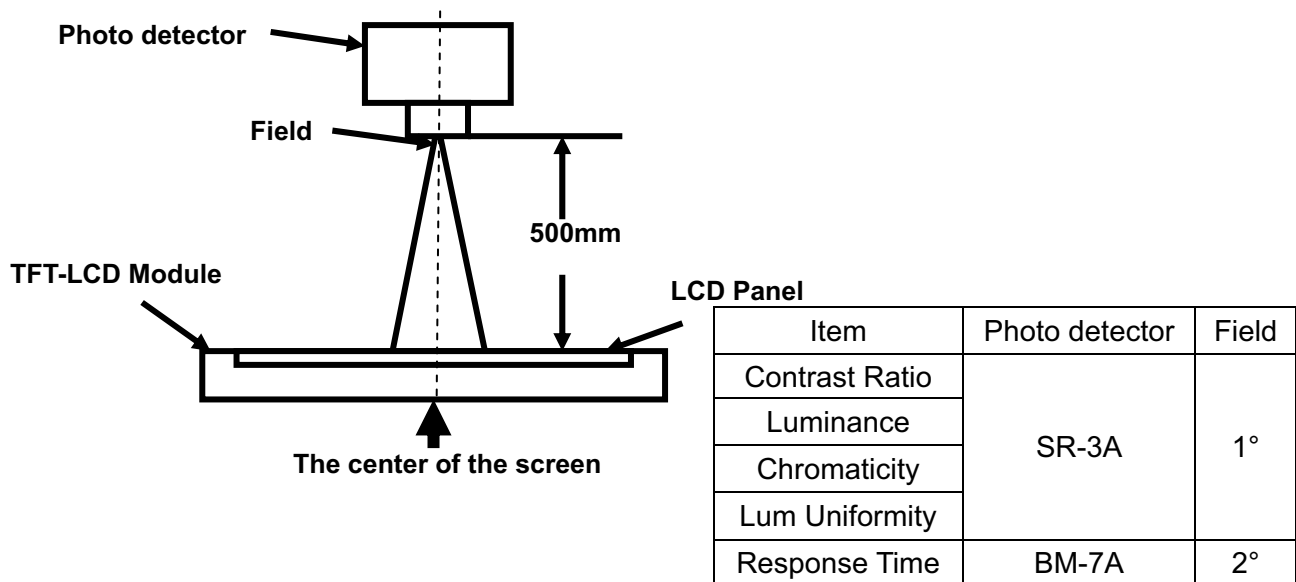
Test Conditions:

1. VCC=2.8V,  $I_L=20\text{mA}$ (LED current), the ambient temperature is 25℃.
2. The test systems refer to Note1 and Note2.



## 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).

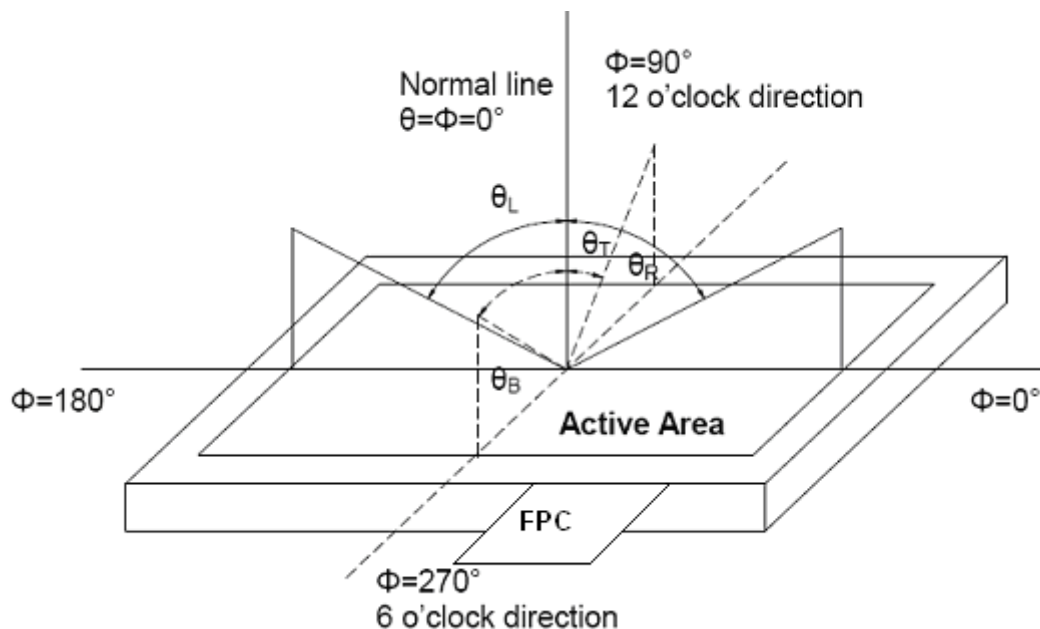


Fig. 1 Definition of viewing angle



**Note 3: Definition of contrast ratio**

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

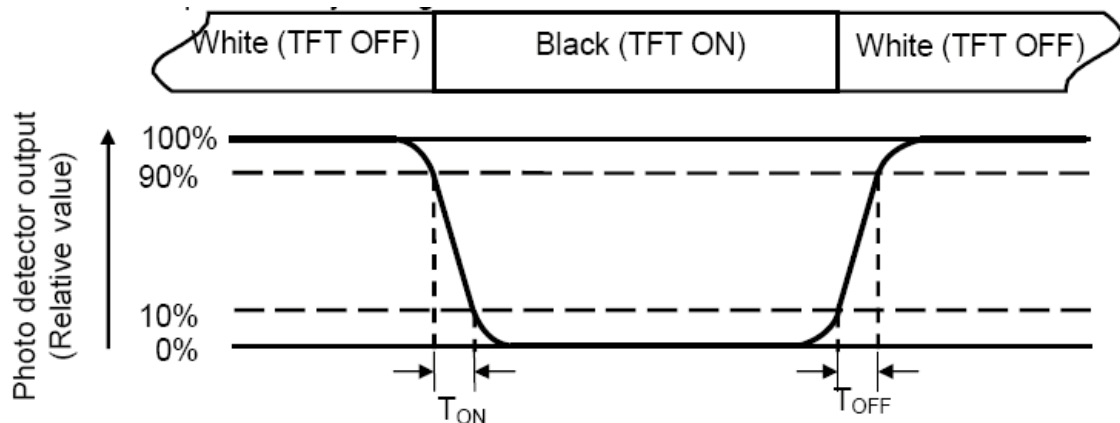
"White state": The state is that the LCD should driven by  $V_{\text{white}}$ .

"Black state": The state is that the LCD should driven by  $V_{\text{black}}$ .

$V_{\text{white}}$ : To be determined     $V_{\text{black}}$ : 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 ( $T_{\text{ON}}$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_{\text{OFF}}$ ) 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

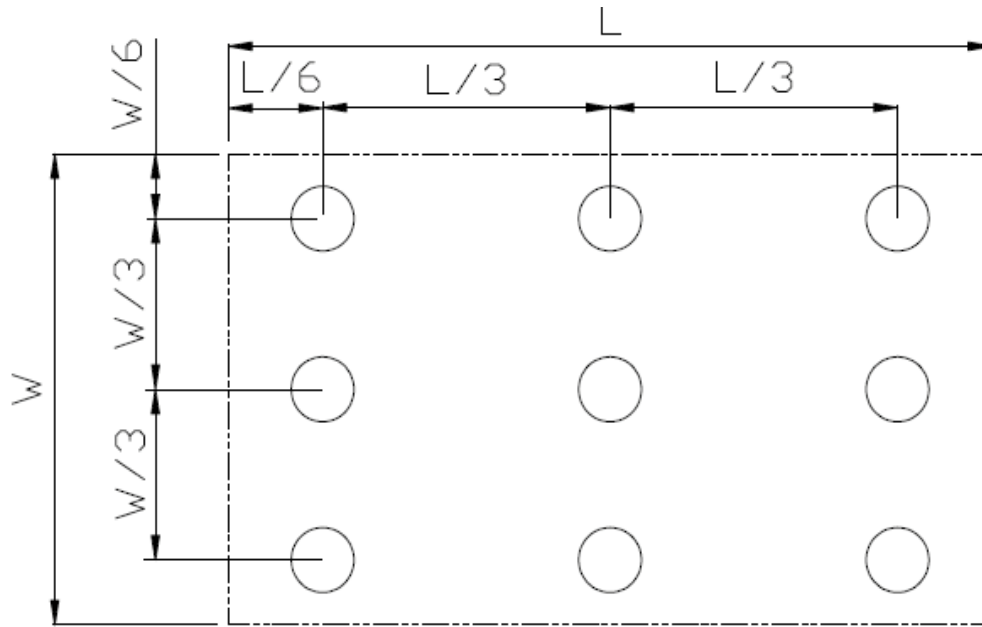


Fig. 2 Definition of uniformity

$L_{\max}$ : The measured maximum luminance of all measurement position.

$L_{\min}$ : 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 Test

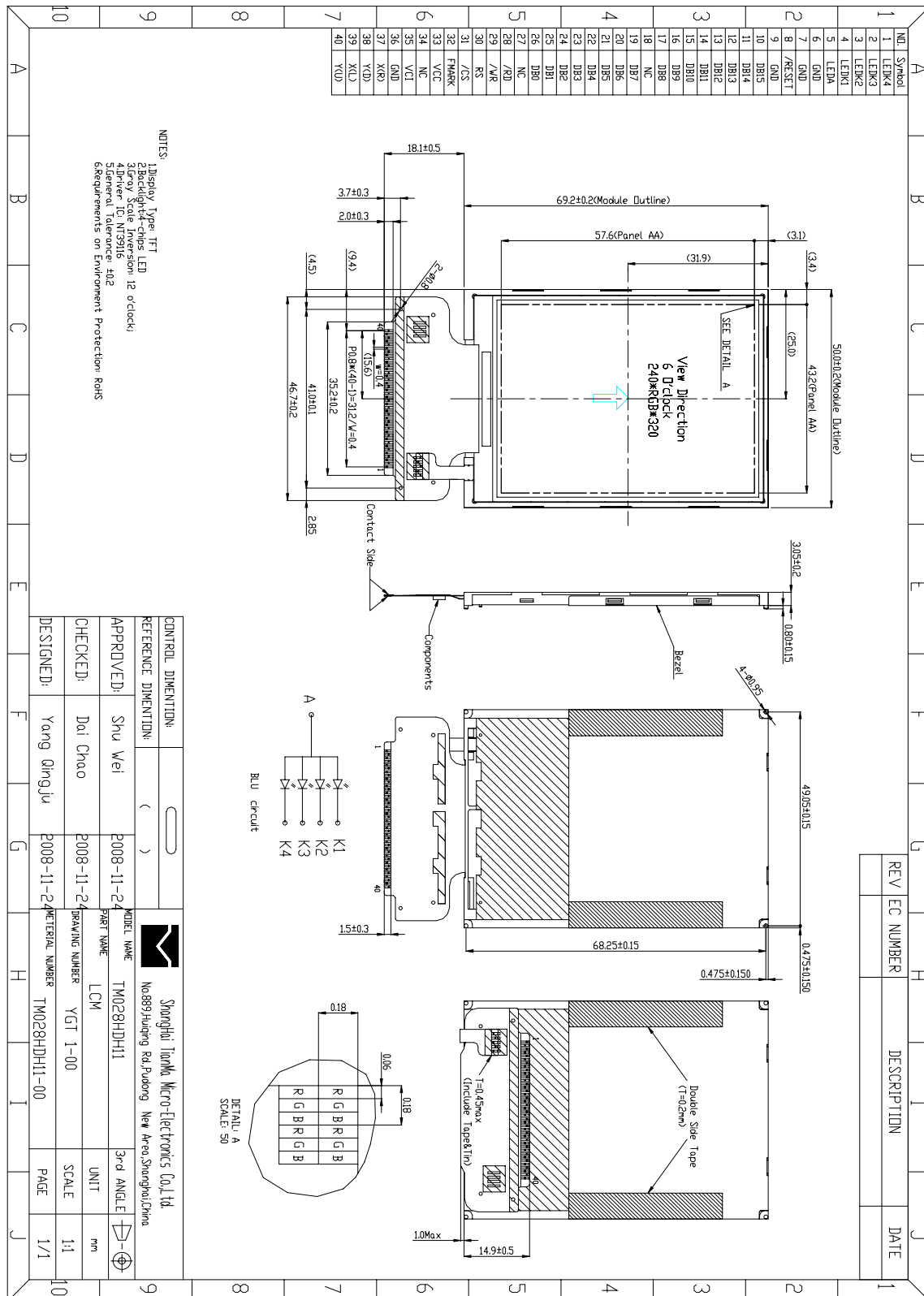
No	Test Item	Condition	Remark
1	High Temperature Operation	Ts=+70℃, 240hrs	Note1 IEC60068-2-2,GB2423.2—89
2	Low Temperature Operation	Ta=-20℃, 240hrs	IEC60068-2-1 GB2423.1—89
3	High Temperature Storage	Ta=+80℃, 240hrs	IEC60068-2-2, GB2423.2—89
4	Low Temperature Storage	Ta=-30℃, 240hrs	IEC60068-2-1 GB2423.1—89
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, 20 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22—87
7	Electro Static Discharge (Operation)	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 (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

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

Note2: Ta is the ambient temperature of sample.



## 8 Mechanical Drawing





## 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

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:
- 10.2.3 Temperature: 0°C~40°C Relatively humidity: ≤80%
- 10.2.4 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.