MODEL NO. : TM028HBH24

ISSUED DATE: 2010-03-26

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	2010-03-26	Preliminary Specification Release	

1 General Specifications

Feature		Spec
Display Spec.	Size	2.83 inch
	Resolution	240(RGB) x 320
	Interface	CPU 16 bits
	Color Depth	65 K
	Technology Type	a-Si TFT
	Dot Pitch (mm)	0.060x0.180
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	TM with Normally White
	Surface Treatment(Up Polarizer)	Clear type (3H)
	Surface Treatment(TSP)	Clear type (3H)
	Viewing Direction	6 o'clock
	Gray Scale Inversion Direction	12 o'clock
Mechanical Characteristics	LCM (W x H x D) (mm)	50.0x69.2x4.2
	Active Area(mm)	43.2 x 57.6
	With /Without TSP	With 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: Q/S0002

Note 3 : LCM weight tolerance : ± 5%

2 Input/Output Terminals

2.1 TFT LCD Panel

No	Symbol	I/O	Description	Comment
1	LEDK4	I	LED cathode	
2	LEDK3	I	LED cathode	
3	LEDK2	I	LED cathode	
4	LEDK1	I	LED cathode	
5	LEDA	I	LED anode	
6	GND	P	Power Ground	
7	GND	P	Power Ground	
8	/RESET	I	Reset	
9	GND	P	Power Ground	
10	DB15	I/O	Data input	
11	DB14	I/O	Data input	
12	DB13	I/O	Data input	
13	DB12	I/O	Data input	
14	DB11	I/O	Data input	
15	DB10	I/O	Data input	
16	DB9	I/O	Data input	
17	DB8	I/O	Data input	
18	NC	--	Not connect	
19	DB7	I/O	Data input	
20	DB6	I/O	Data input	
21	DB5	I/O	Data input	
22	DB4	I/O	Data input	
23	DB3	I/O	Data input	
24	DB2	I/O	Data input	
25	DB1	I/O	Data input	
26	DB0	I/O	Data input	
27	NC	--	Not connect	
28	/RD	I	Read strobe	
29	/WR	I	Write strobe	
30	/RS	I	Register select	
31	/CS	I	Chip select	
32	FMARK	O	Frame pulse head signal	
33	IOVCC	P	I/O power supply for LCD driver	
34	NC	--	Not connect	
35	VCI	P	Power Supply of Analog Circuit	
36	GND	P	Power Ground	
37	XR	I/O	Touch Panel X(Right Side)	
38	YD	I/O	Touch Panel Y(12 Clock Side)	
39	XL	I/O	Touch Panel X(Left Side)	
40	YU	I/O	Touch Panel Y(6 Clock Side)	

Note1: I/O definition:

I-----Input O---Output P----Power

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	
Touch Panel Pin Voltage	X(R),Y(D),X(L),Y(U),	--	7.0	V	
Back Light Forward Current	I_{LED}	--	25.0	mA	For each LED
Operating Temperature	T_{OPR}	-20	60	℃	
Storage Temperature	T_{STG}	-30	70	℃	

4 Electrical Characteristics

4.1 Driving TFT LCD Panel

GND=0V, Ta=25℃

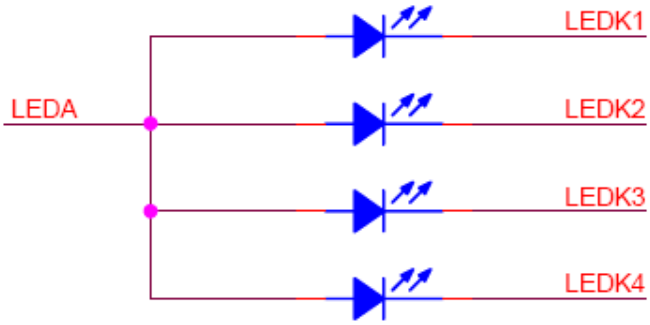
Item		Symbol	MIN	TYP	MAX	Unit	Remark
Logic Supply Voltage		VCC	1.65	2.8	3.3	V	
Analog Supply Voltage		VCI	2.5	2.8	3.3	V	
Input Signal Voltage	Low Level	VIL	DGND	--	0.3VCC	V	
	High Level	VIH	0.7VCC	--	VCC	V	
Output Signal Voltage	Low Level	VOL	DGND	--	0.2VCC	V	
	High Level	VOH	0.8VCC	--	VCC	V	
(Panel+LSI) Power Consumption		Black Mode	--	--	10	mA	60HZ(frame rate)
		8 color Mode	--	TBD	--		
		Sleeping Mode	--	TBD	--		

4.2 Driving Backlight

Ta=25℃

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	--	20	25	mA	One LED
Forward Current Voltage	V_F	--	3.2	--	V	One LED
Backlight Power Consumption	W_{BL}	--	256	--	mW	4 LEDs

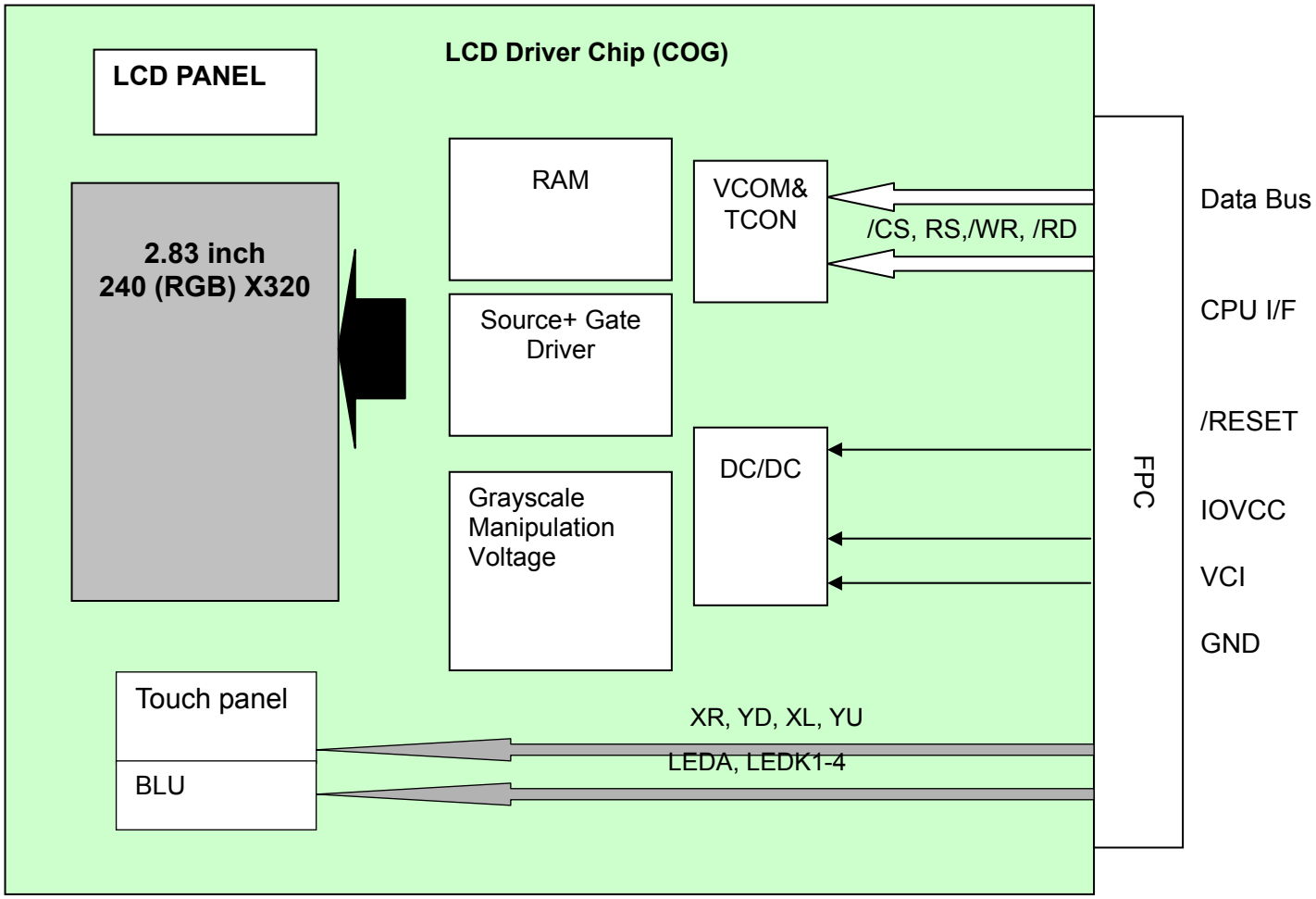
Note 1: The figure below shows the connection of backlight LED.



Note 2: One LED : I_F =20 mA, V_F =3.2V

Note 3: IF is defined for one channel LED.
Optical performance should be evaluated at Ta=25℃ only.
If LED is driven by high current, high ambient temperature & humidity condition, the life time of LED will be reduced.
Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

4.3 Block Diagram



5 Timing Chart

5.1 Timing Parameter

Signal	Symbol	parameter	Min	Max	Unit	Discription
/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_{RCSFM}	Chip select setup time(read FM)	355	-	ns	
	t_{CSF}	Address 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
	t_{DHT}	Data hold time	10	-	ns	
	t_{RAT}	Read access time (ID)	-	-	ns	
	t_{RATFM}	Read access time (FM)	-	-	ns	
	T_{ODH}	Output disable time	20	-	ns	

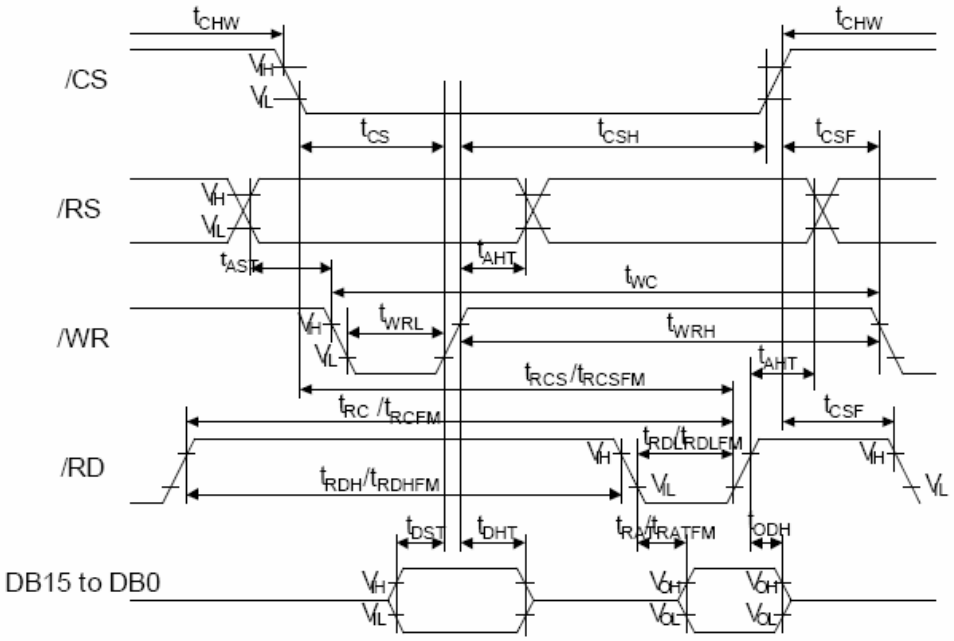


Figure 5.1 i80 System Bus Timing

5.2 Register write timing

Figure 5.2 i80 16-bit System Bus Interface Timing(Register Write Timing)

5.3 GRAM write timing

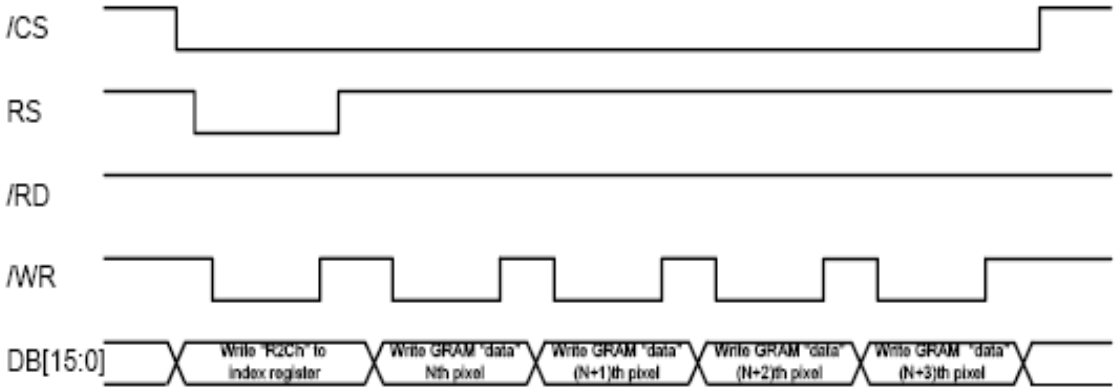


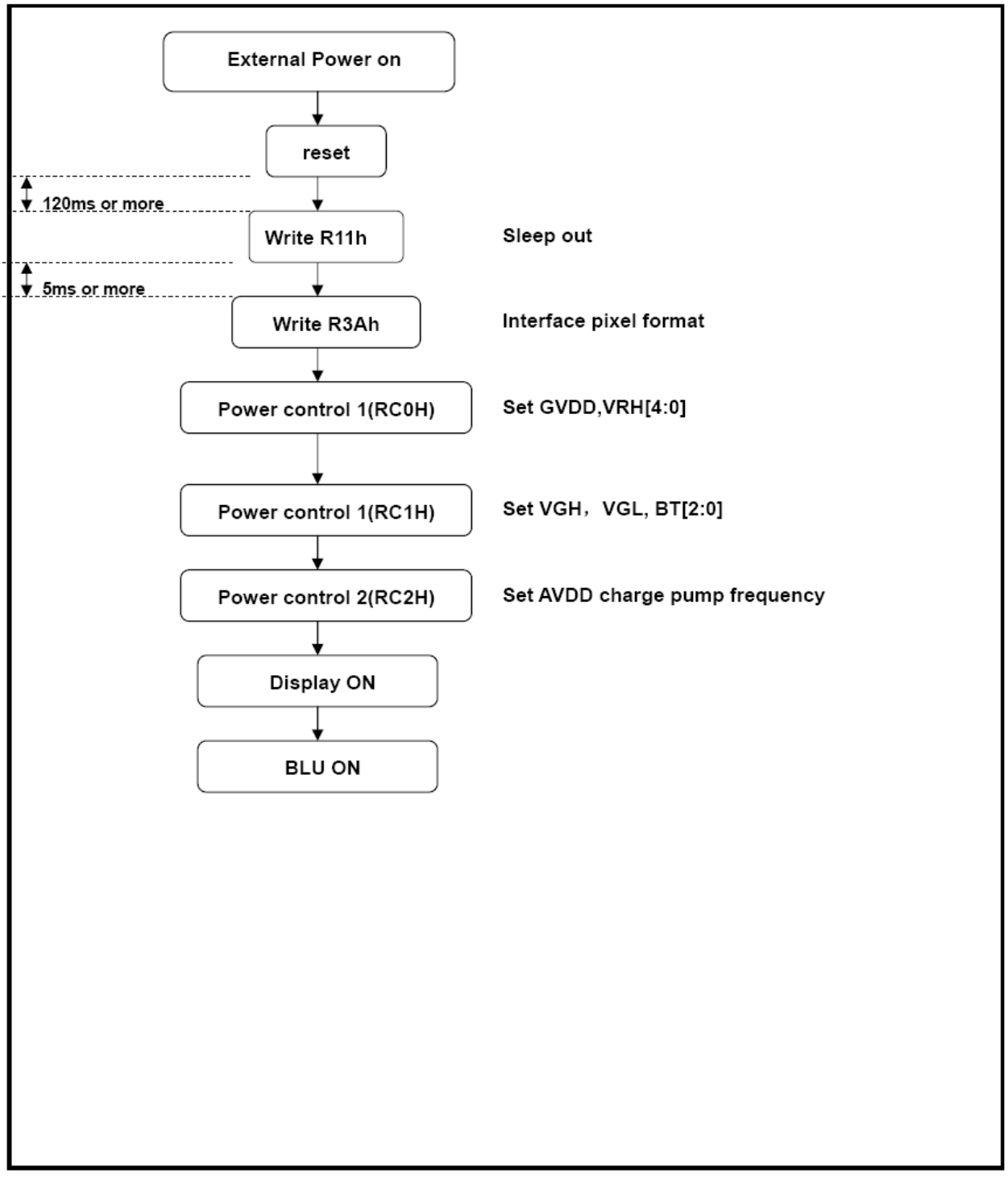
Figure 5.3.1 i80 16-bit System Bus Interface Timing (GRAM Write Timing)

Register Command	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	Register
	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	

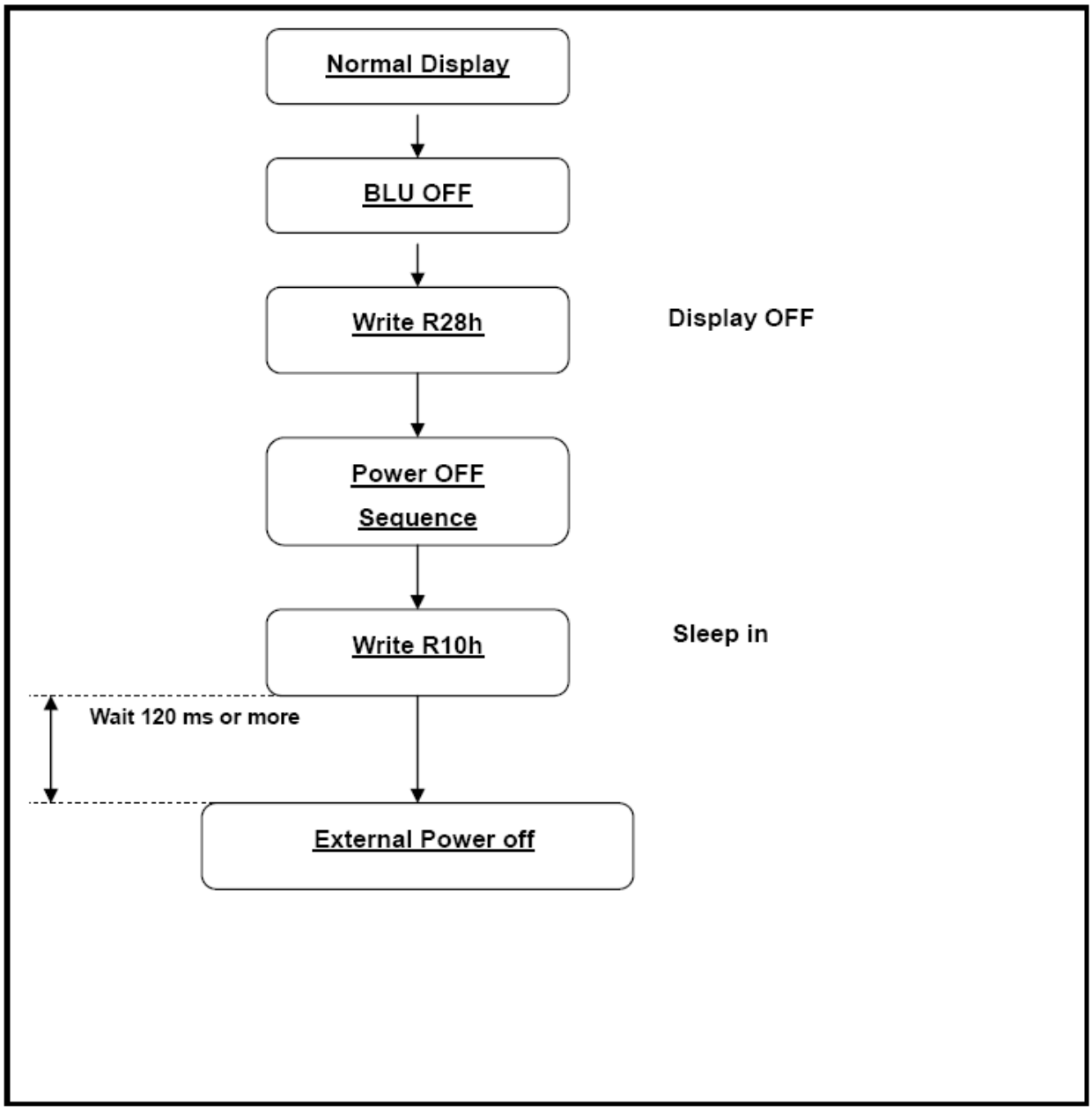
Figure 5.3.2 i80-System Interface with 16-bit Data Bus

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℃

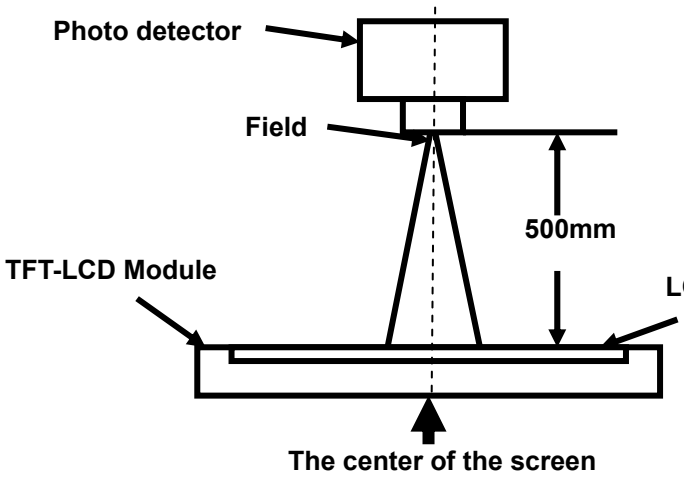
Item		Symbol	Condition	MIN	TYP	MAX	Unit	Remark
View Angles		θT	CR≧10	50	60	-	Degree	Note 2
		θB		30	40	-		
		θL		50	60	-		
		θR		50	60	-		
Contrast Ratio		CR	θ=0°	200	350	-		Note1 Note3
Response Time		T_{ON}	25℃	-	25	40	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.260	0.310	0.360		Note5, Note1
		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	-	%	Note 5
Luminance(TSP)		L		170	220	-	cd/m^2	Note1 Note7

Test Conditions:

1. V_F =3.2V ,I_F =20 mA (One LED current), the ambient temperature is 25℃.
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.



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)。

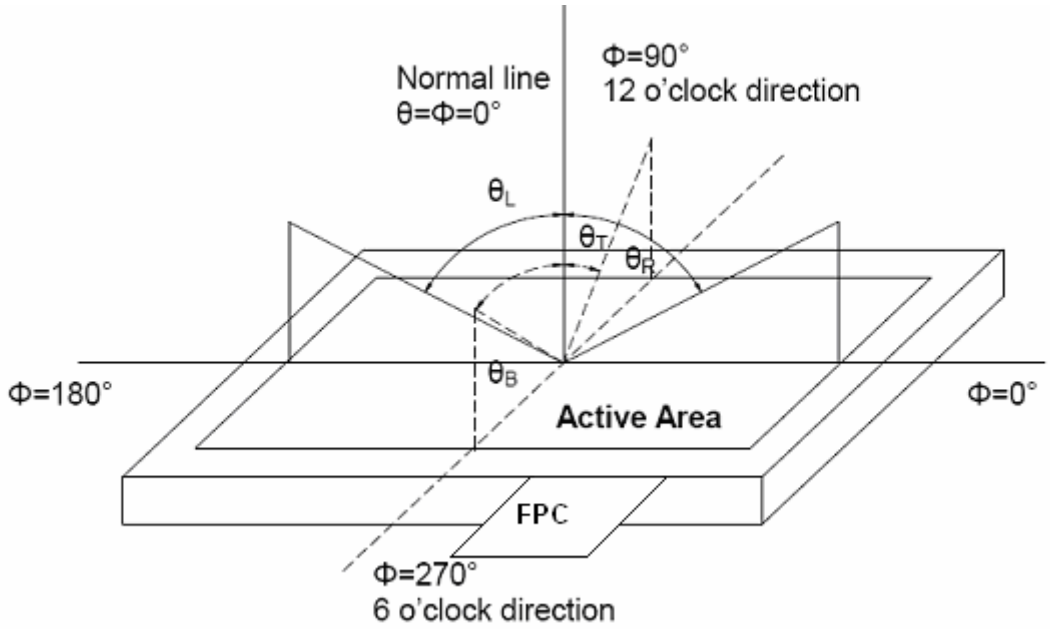


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

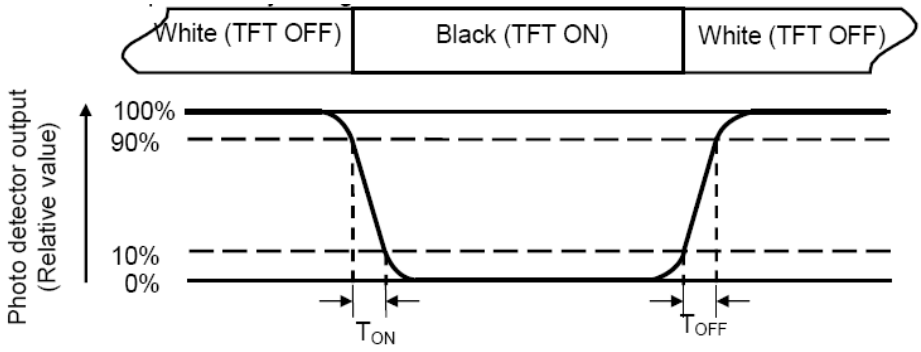
“White state “:The state is that the LCD should driven by Vwhite.

“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.

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

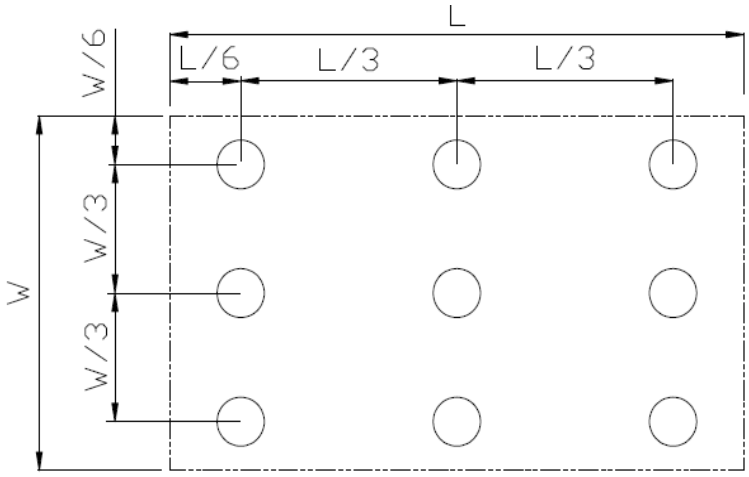


Fig. 2 Definition of uniformity

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.

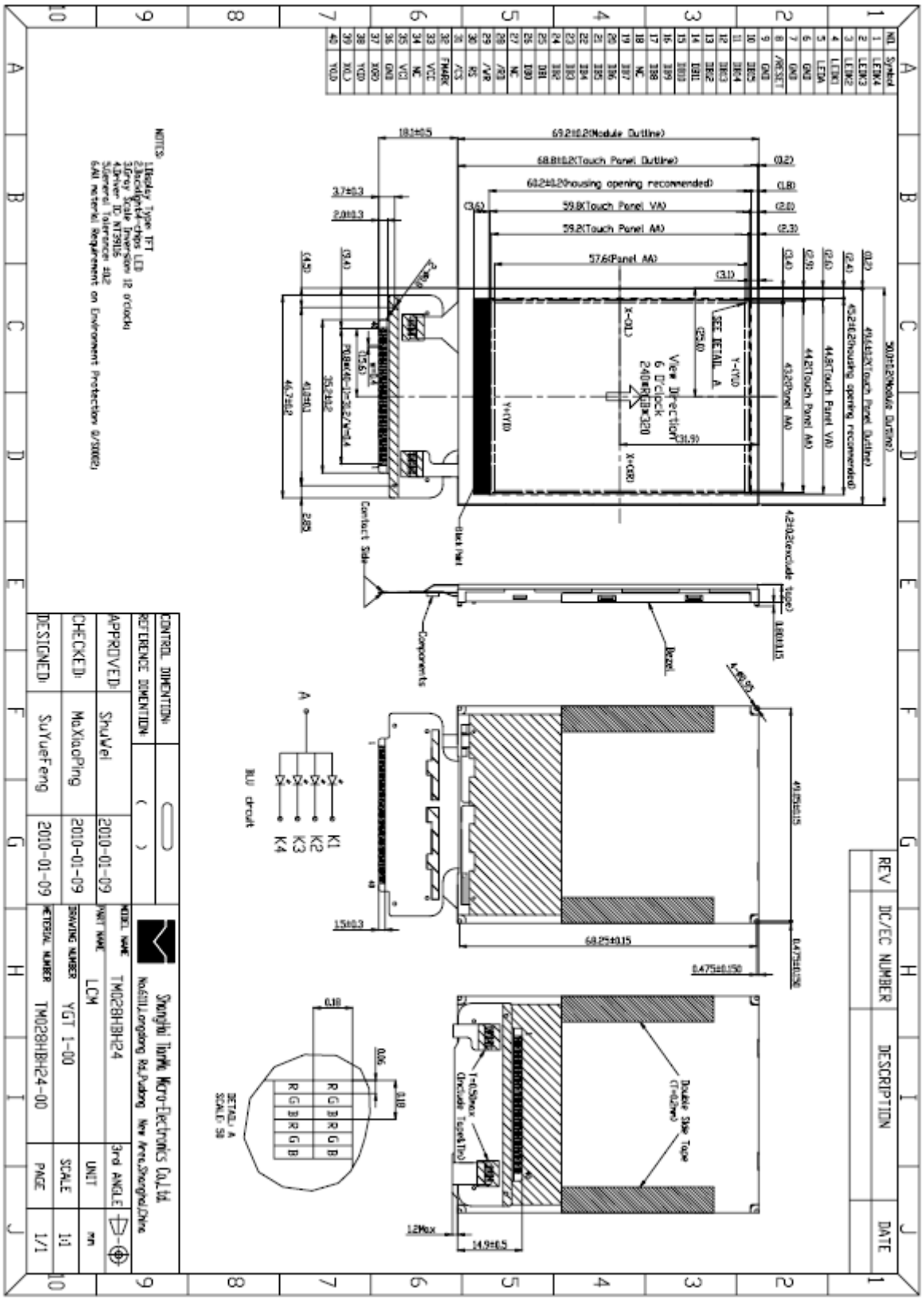
7 Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts=+60℃, 240hrs	Note1 IEC60068-2-1,GB2423.2
2	Low Temperature Operation	Ta=-20℃, 240hrs	IEC60068-2-1 GB2423.1
3	High Temperature Storage	Ta=+70℃, 240hrs	IEC60068-2-1 GB2423.2
4	Low Temperature Storage	Ta=-30℃, 240hrs	IEC60068-2-1 GB2423.1
5	High Temperature & High Humidity Storage	Ta=+60℃, 90% RH 240 hours	Note2 IEC60068-2-78 GB/T2423.3
6	Thermal Shock (Non-operation)	-30℃ 30 min~+70℃ 30 min, Change time:5min, 20 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22
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
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
9	Shock (Non-operation)	60G 6ms, ±X,±Y,±Z 3times, for each direction	IEC60068-2-27 GB/T2423.5
10	Package Drop Test	Height:80 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8

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

Note2: Ta is the ambient temperature of sample.

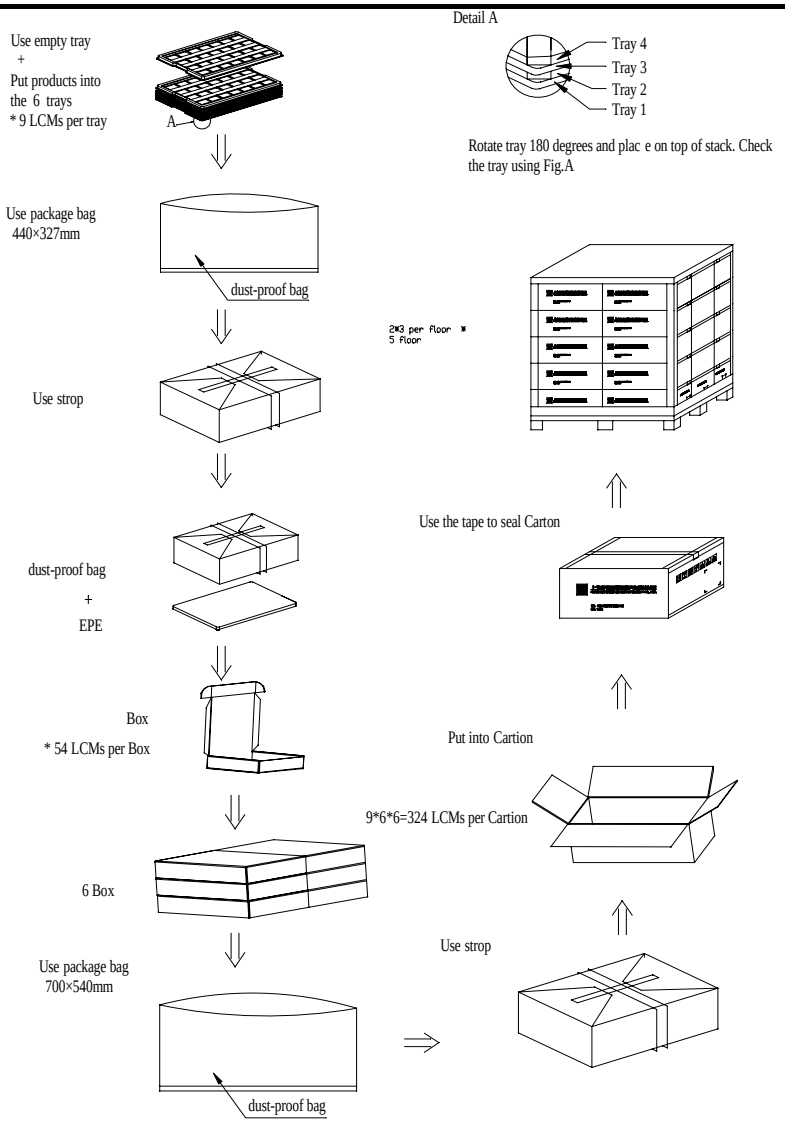
8 Mechanical Drawing



9 Packing Drawing

9.1 Packaging Material Table

No	Item	Model(Material)	Dimensions (mm)	Unit Weigt (Kg)	Quantity	Remark
1	LCM	TM028HBH03	50.0x69.2x4.2	TBD	324	
2	Tray	PET(Transmit)	315.0x247.0x11.6	0.079	42	Anti-static
3	EPE	EPE	315.0X247.0X5.0	0.009	6	
4	Dust-Proof Bag	PE	700.0x545.0	0.046	1	
5	Anti-static bag	PE	327.0x440.0	0.021	6	
6	Box	Corrugated Paper	345.0x260.0x70.0	0.227	6	
7	Carton	Corrugated Paper	544.0x365.0x250.0	1.010	1	
8	Total Weight (Kg)	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:

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.