MODEL NO. :   TM014EDH23

ISSUED DATE: 2012-2-20

VERSION   :   Ver 1.3

□**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	2012-01-05	Final spec Release	Sophia

1   General Specifications

Feature		Spec
Display Spec	Size	1.44 inch
	Resolution	128(RGB) x 128
	Interface	SPI 4W
	Color Depth	65/262k
	Technology Type	a-Si
	Pixel Pitch (mm)	0.1992(H)*0.2070(V)
	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)	32.36x38.00x2.60
	Active Area(mm)	25.50*26.50
	With /Without TSP	Without TSP
	Weight (g)	4.235
	LED Numbers	1 LED
Electronic	Driver IC	ST7735S

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: $\pm$ 5%

2 Input/Output Terminals

2.1   TFT LCD Panel

No	Symbol	I/O	Description	Remarks
1	NC	-	dummy	
2	VSS	p	ground	
3	LED_A	I	LED Anode	
4	LED_K	I	LED Cathode	
5	VSS	p	ground	
6	/RET	I	A reset signal	
7	A0	I	Commond or/and data select pin	
8	SDA	I/O	Serial data input/output	
9	SCK	I	serial clock	
10	VDDA(2.8V)	P	Analog power supply	
11	VDDIO(1.8/2.8)	P	Digital power supply	
12	/CS	I	Chip select signal , low: chip can be accessed	
13	VSS	p	ground	
14	MAKER_ID(LOW)	O	Customer Identification pin，connect to GND	

Note1:   I/O definition：I-----Input   O---Output   P----Power/ Ground   NC--- Not Connected

3 Absolute Maximum Ratings

3.1 Driving TFT LCD Panel

Item	Symbol	Min.	Typ.	Max.	Unit	Condition	Remark
Power For Analogue Circuit	VCI	2.5	-	4.8	V		
Power for Logic Circuit	IOVCC	1.65	-	3.7	V		
Storage Temperature	Tstg	-30	-	80	˚C		
Operating Ambient Temperature	Topr	-20	-	70	˚C		
Operating Ambient Humidity	-	-	-	90	%RH		

Ta = 25°C

4   Electrical Characteristics

4.1   Driving TFT LCD Panel

GND=0V, Ta=25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Supply Voltage	VCI	2.5	2.75	4.8	V	
Supply Voltage	IOVCC	1.65	1.8	3.7	V	
High-level Input Voltage	VIH	0.7* IOVCC	-	IOVCC	V	
Low-level Input Voltage	VIL	0	-	0.3* IOVCC	V	
High-level Output Voltage	VOH	0.8* IOVCC	-	IOVCC	V	
Low-level Output Voltage	VOL	0	-	0.2* IOVCC	V	
Supply Current for LED	IF	-	20	25	mA	Each LED
Supply Current for Logic	-	-	1.35	2.03	mA	
Sleep Current	-	-	0.008	0.014	mA	
Frame Frequency	-	-	60	90	HZ	

* Test Condition: Full Black

4.2   Driving Backlight   Ta=25℃

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I_F	--	15	25	mA	
Forward Voltage	V_F	--	3.1	3.4	V	1 LED
Power Consumption	W_{BL}	--	46.5	--	mW	

Note1:   Figure below shows the connection of backlight LED.

LED_A ———————▷|——————— LED_K
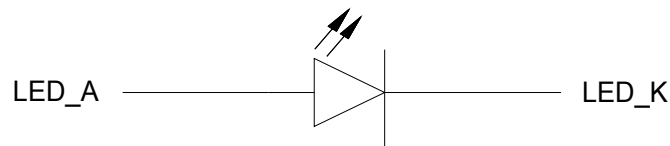
Note 2: One LED: I_F =15 mA, V_F =3.1

4.3 Block Diagram

LCD Panel

RAM

VCOM & TCON

1.4 inch
128(RGB)*128

Source + Gate Driver

DC/DC

Grayscale Manipulation Voltage

BLU

SDA

A0,SDA,SCL.CS

RESET

VDDA VDDIO GND

LED+,LED-

F P C

Data BUS
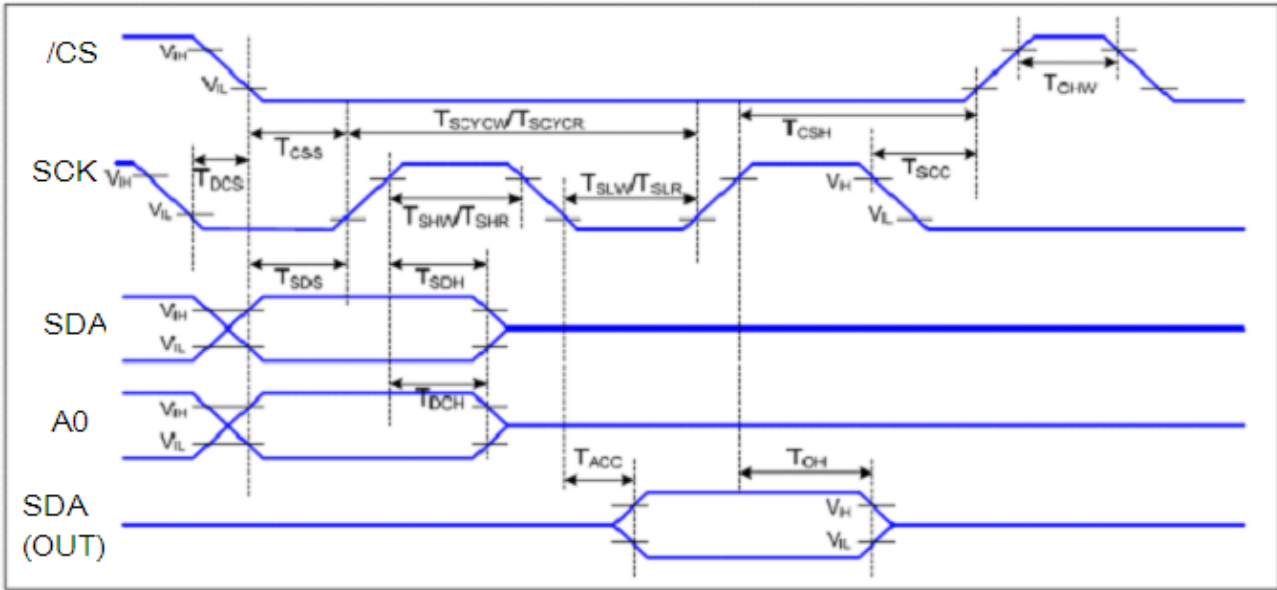
Control signal input interface

RESET

power

BLU
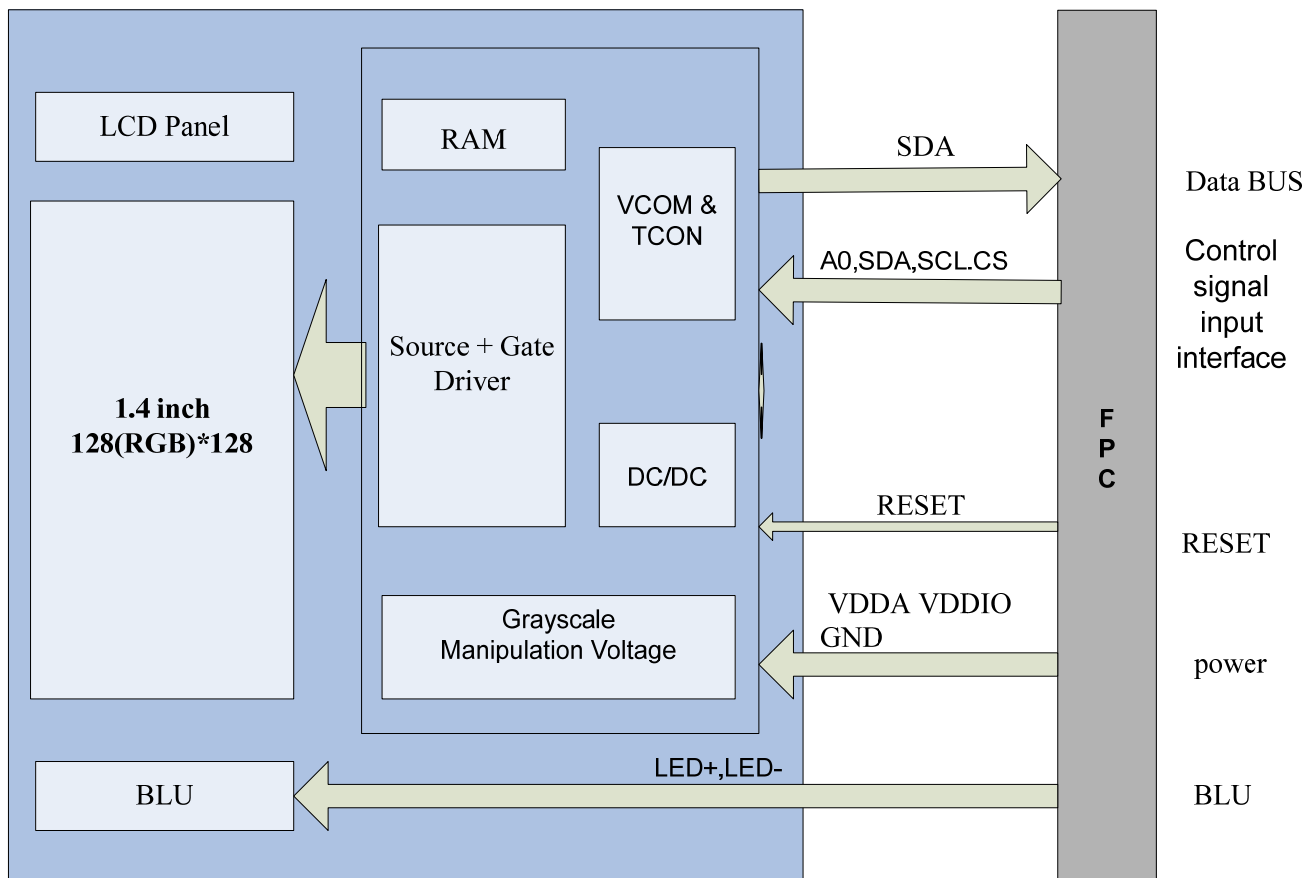
5   Timing Chart

5.1   4-Wire SPI Interface Timing Characteristics

Interface Characteristics

5.2   4-Wire SPI Interface Timing Parameters
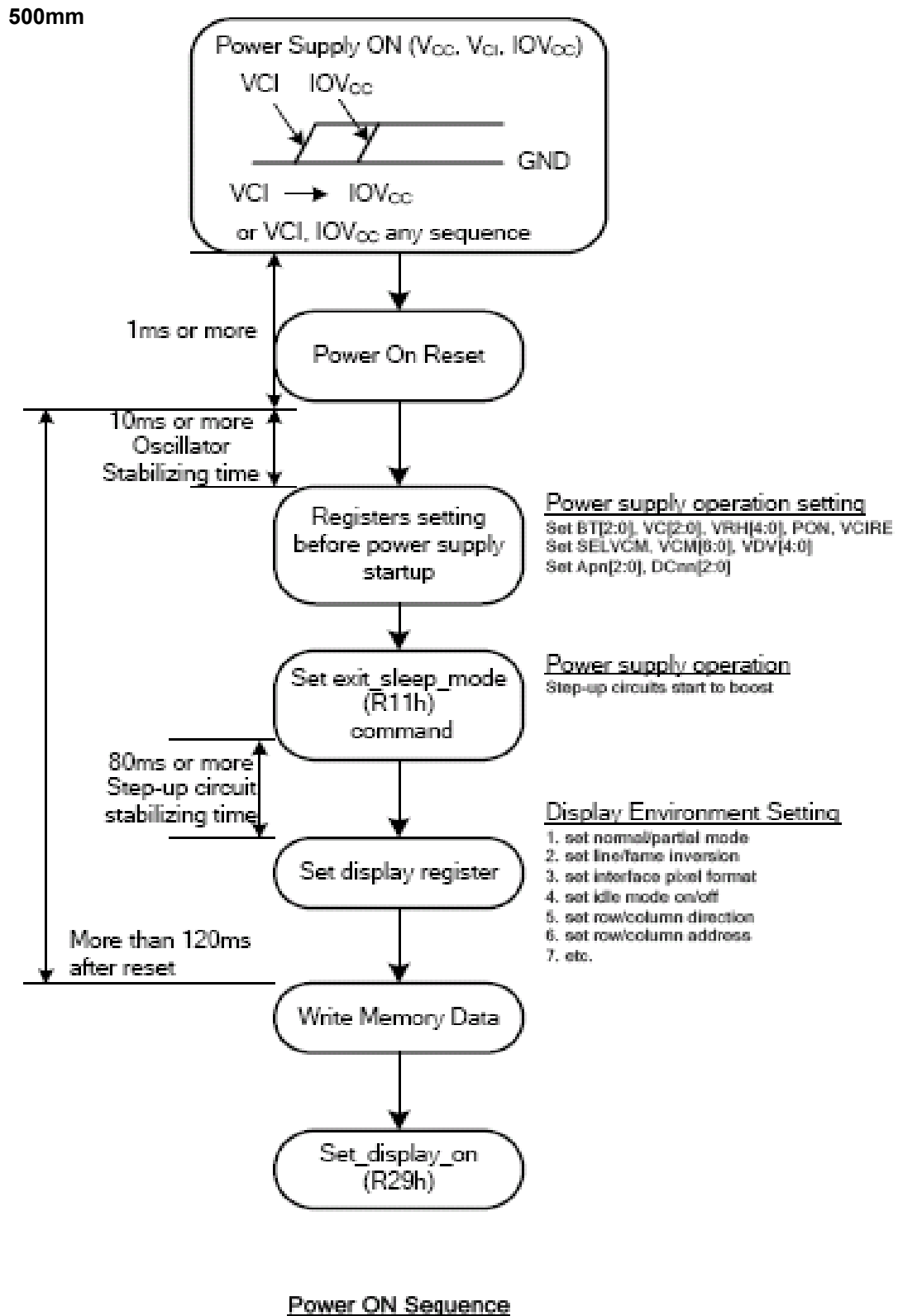Normal Write Mode (IOVCC=1.65 to 3.3V, VCC=2.5 to 4.8V)

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
/CS	TCSS	Chip Select Setup Time (Write)	45		ns	
	TCSH	Chip Select Hold Time (Write)	45		ns	
	TCSS	Chip Select Setup Time (Read)	60		ns	
	TSCC	Chip Select Hold Time (Read)	65		ns	
	TCHW	Chip Select "H" Pulse Width	40		ns	
SCK	TSCYCW	Serial Clock Cycle (Write)	66		ns	Write Command & Data Ram
	TSHW	SCK "H" Pulse Width (Write)	15		ns	
	TSLW	SCK "L" Pulse Width (Write)	15		ns	
	TSCYCR	Serial Clock Cycle (Read)	150		ns	Read Command & Data Ram
	TSHR	SCK "H" Pulse Width (Read)	60		ns	
	TSLR	SCK "L" Pulse Width (Read)	60		ns	
A0	TDCS	A0 Setup Time	10		ns	
	TDCH	A0 Hold Time	10		ns	
SDA	TSDS	Data Setup Time	10		ns	For Maximum CL=30pF For Minimum CL=8pF
	TSDH	Data Hold Time	10		ns	
	TACC	Access Time	10	50	ns	
	TOH	Output Disable Time	15	50	ns	

Interface Timing Parameters

5.3 Power on Sequence

500mm

Power Supply ON (V_{CC}, V_{CI}, IOV_{CC})

VCI → IOV_{CC}

or VCI, IOV_{CC} any sequence

1ms or more

Power On Reset

10ms or more
Oscillator
Stabilizing time

Registers setting before power supply startup

Power supply operation setting
Set BT[2:0], VC[2:0], VRH[4:0], PON, VCIRE
Set SELVCM, VCM[6:0], VDV[4:0]
Set Apn[2:0], DCnn[2:0]

Set exit_sleep_mode (R11h) command

Power supply operation
Step-up circuits start to boost

80ms or more
Step-up circuit
stabilizing time

Set display register

Display Environment Setting
1. set normal/partial mode
2. set line/fame inversion
3. set interface pixel format
4. set idle mode on/off
5. set row/column direction
6. set row/column address
7. etc.

More than 120ms
after reset

Write Memory Data

Set_display_on (R29h)

Power ON Sequence

5.4 Display On/Off Sequence

Display On Sequence			
1	0x29		Display On
2		100ms	

Display Off Sequence			
Step	**Reg.**	**Data**	**Delay**	**Command**
1	0x28			Display Off
2			120ms	

5.5 Deep Standby Mode On

Enter Deep Standby Mode			
1	0x10			Sleep In
2			120ms	

5.6 Deep Standby Mode Off

Step	Reg.	Data	Delay	Command
Exit Deep Standby Mode				
1	0x11			Sleep Out
2			120ms	
3	0x29			Display On

5.7   Initial Sequence

Step	Reg.（0x）	Data（0x）	Delay	Command
Initial Sequence				
Condition: VCC= 2.5~3.3V, IOVCC =1.65~3.3V				
1				Power on RESET
2	0x11			Exit Sleep
3			120ms	
4	0xB1			
5		0x02		
6		0x35		
7		0x36		
8	0xB2			
9		0x02		
10		0x35		
11		0x36		
12	0xB3			
13		0x02		
14		0x35		
15		0x36		
16		0x02		
17		0x35		
18		0x36		
19	0xB4			
20		0x07		
21	0xB6			
22		0xB4		
23	0xC0			
24		0xA2		
25		0x02		
26		0x04		
27	0xC1			
28		0xA0		
29	0xC2			
30		0x0B		
31		0x00		
32	0xC3			
33		0x8B		
34		0x2A		
35	0xC4			
36		0x8B		
37		0xEE		
38	0xC5			
39		0x0B		

40	0x36			read/ write scanning direction of frame memory
41		0xC8		
42	0x3A			Interface Pixel Format
43		0x05		05: 65K 06:262K
78	0x2A			
79		0x00		
80		0x02		
81		0x00		
82		0x81		
83	0x2B			
84		0x00		
85		0x03		
86		0x00		
87		0x82		
44	0xE0			
45		0x11		
46		0x1F		
47		0x09		
48		0x08		
49		0x26		
50		0x1F		
51		0x1A		
52		0x22		
53		0x1C		
54		0x1F		
55		0x29		
56		0x39		
57		0x00		
58		0x06		
59		0x02		
60		0x10		
61	0xE1			
62		0x11		
63		0x1F		
64		0x0F		
65		0x12		
66		0x27		
67		0x26		
68		0x20		
69		0x23		
70		0x28		
71		0x26		
72		0x2D		

73		0x3A		
74		0x00		
75		0x06		
76		0x02		
77		0x10		
88	0x29			Display On
89			100ms	
90	0x2C			
91			10ms	

5.8 Write Sequence

5.8.1 Write Data For 16-bit/pixel (RGB 5-6-5 bit input)
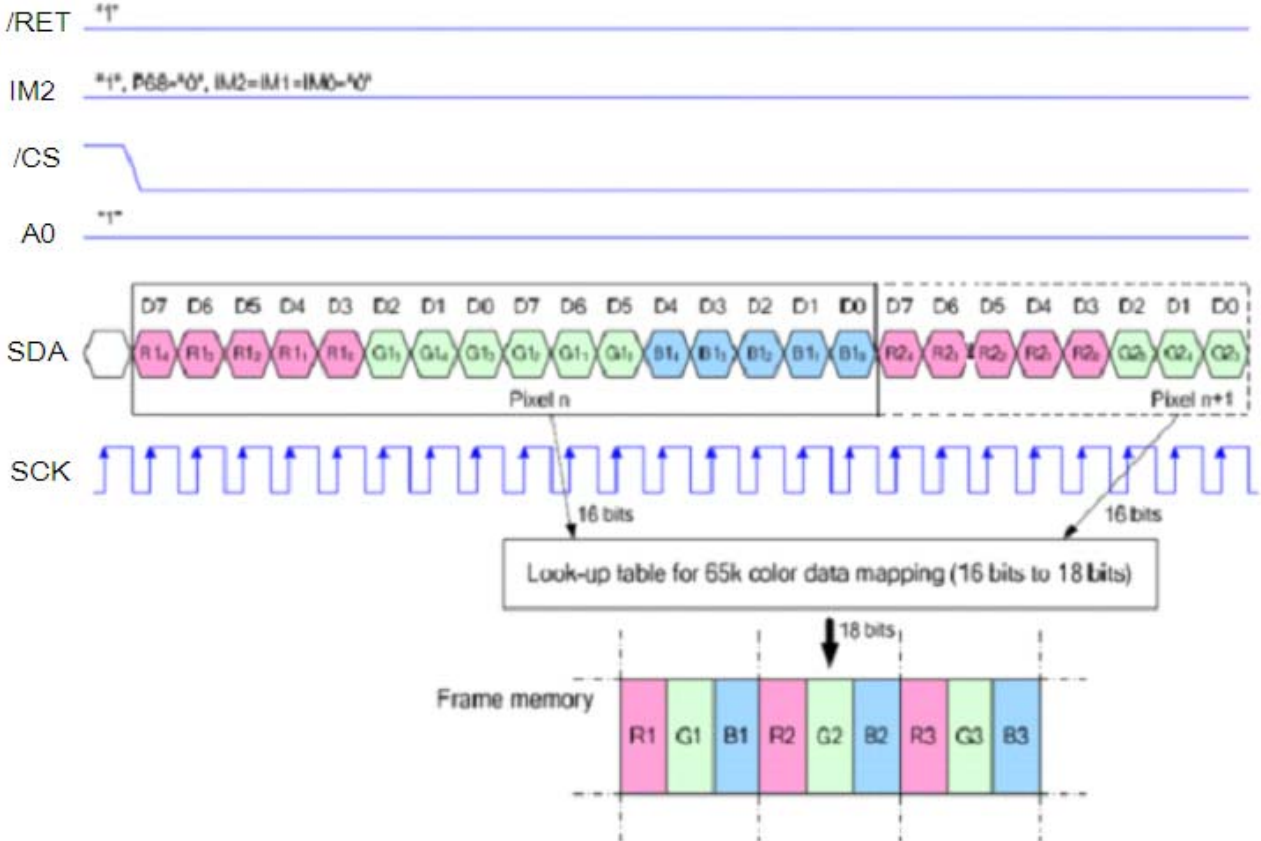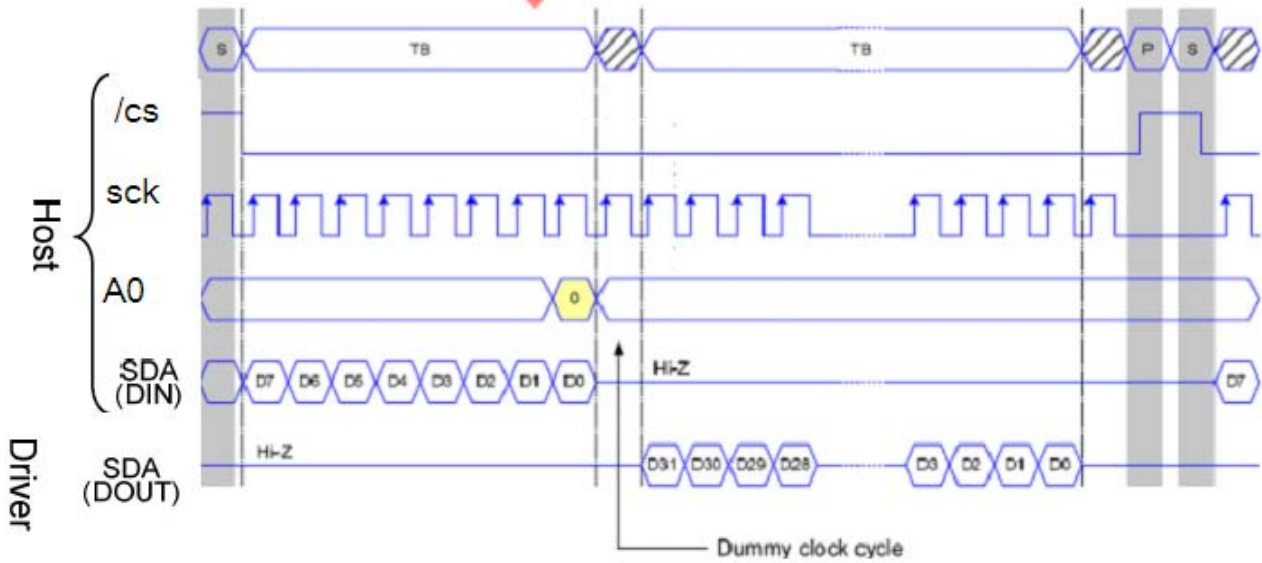

5.8.2 Write Data For 18-bit/pixel (RGB 6-6-6bit input)
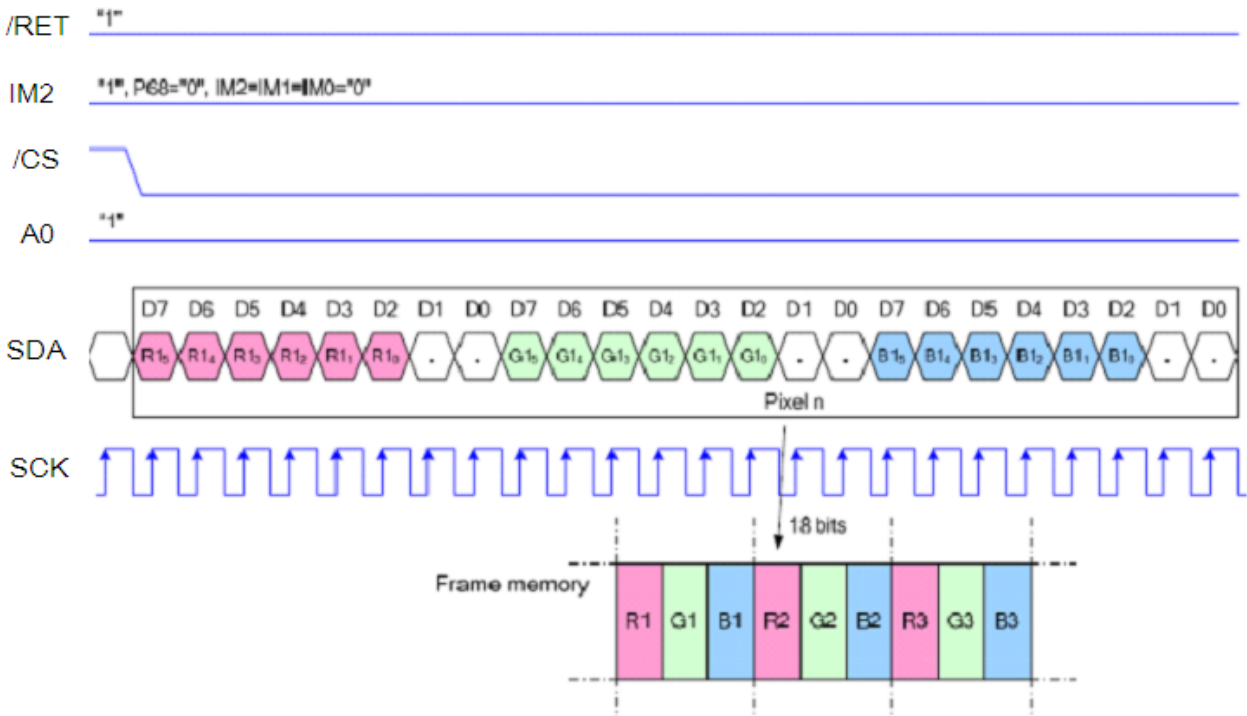
5.9 Load Sequence

5.9.1   4-Wire serial Protocol Read(for RDDID command :32-bit read)

5.9.2   4-Wire serial Protocol Read(for RDDIDst command :24-bit read)
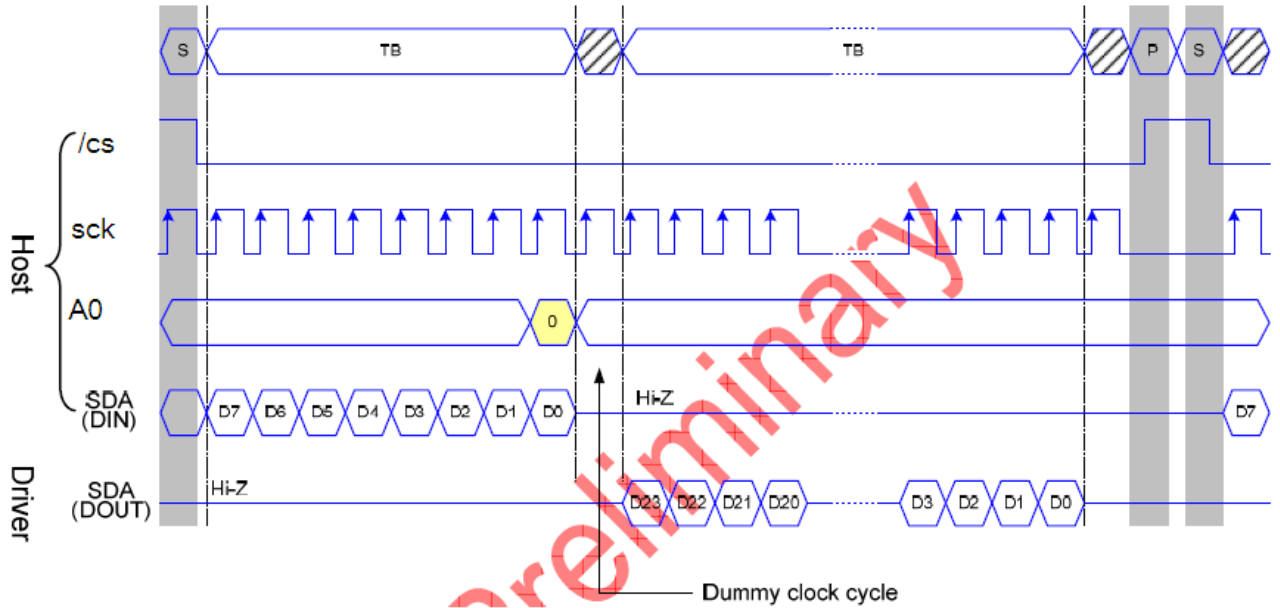
6 Optical Characteristics

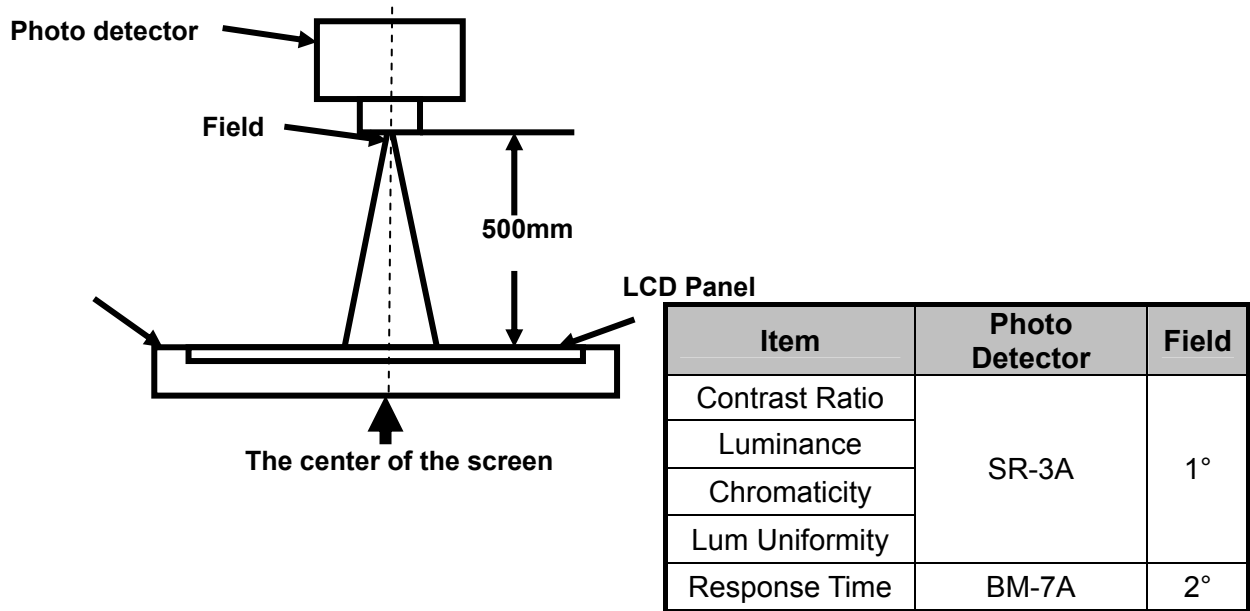| Item		Symbol	Condition	Unit	Min.	Typ.	Max	Notes	Item
Response Time	Rise	Tr+Tf		ms	-	20	30		
	Fall			ms	-				
Luminance		Bp	Θ = 0˚	cd/㎡	180	210	-		
Luminance uniformity		ΔL	Θ = 0˚	%	75	80	-		
Contrast Ratio		C/R	Θ = 0˚		400	500	-		
Viewing Angle	Top		CR≥10	Degree	60	70	-		
	Bottom				50	60	-		
	Right				60	70	-		
	Left				60	70	-		
Color Coordination	Rx		Θ = 0˚	NTSC (x.y)	0.538	0.588	0.638		
	Ry				0.277	0.327	0.377		
	Gx				0.292	0.342	0.392		
	Gy				0.531	0.581	0.631		
	Bx				0.101	0.151	0.201		
	By				0.054	0.104	0.154		
	Wx				0.244	0.294	0.344		
	Wy				0.275	0.325	0.375		

Test Conditions:

1. V_F=3.2V, I_F=15mA, 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	SR-3A	1°
Chromaticity	SR-3A	1°
Lum Uniformity	SR-3A	1°
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)。
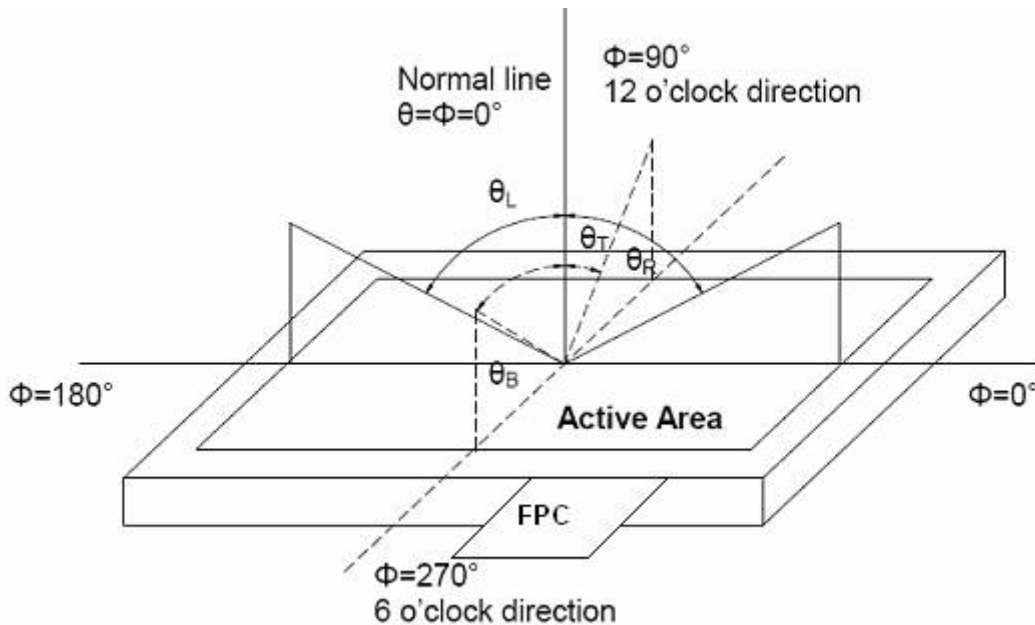
Fig. 1 Definition of viewing angle

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%.
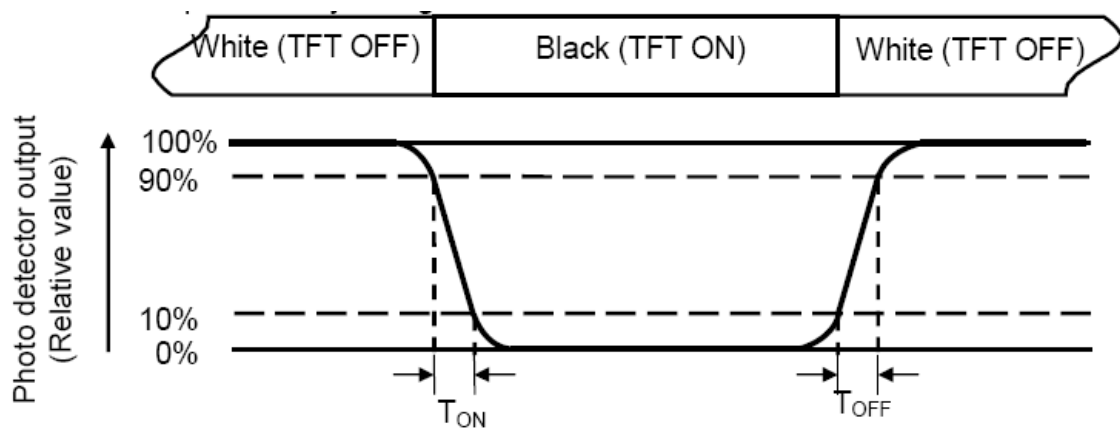
Note 5: Definition of color chromaticity (CIE1931)

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

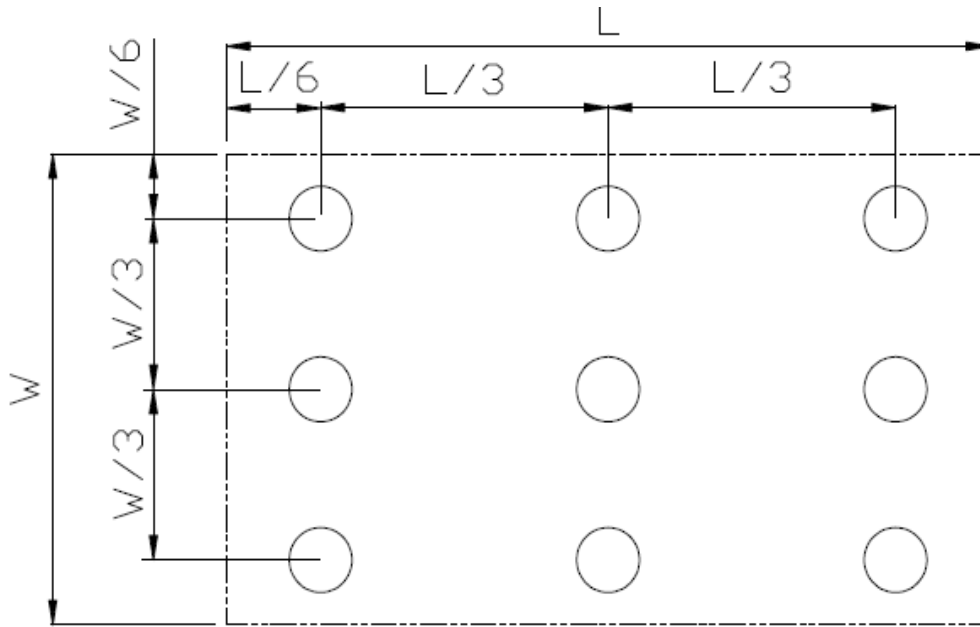L-------Active area length W----- Active area width

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	Remark
1	High Temperature Operation	70℃ , 96 Hr	
2	Low Temperature Operation	-20℃, 96 Hr	
3	High Temperature & High Humidity Operation	60℃, 90% RH, 96 Hr	
4	High Temperature Storage	80℃, 96HR storage	
5	Low Temperature Storage	-30℃, 96HR storage	
6	Thermal Shock	-30℃, 80℃(30Min) 24cycle	
7	ESD Electrostatic Withstanding Voltage	C=150pF,R=330Ω，5times/panal Air:±3KV,5times; Contact:±3KV,5times; (Environment :15℃~35℃，30%~60%，86KPA~106KPA)	Test Jig
8	Package Vibration Test	10~55Hz,1.5mm, X/Y/Z 6 hours	Packing
9	Packing shock	76cm / 8Corner / 6Face, 1cycle	Packing

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

Note2: Ta is the ambient temperature of sample.

8 Mechanical Drawing

9 Packing Drawing

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	TM014EDH23	33.35×72.64×2.6	0.0046	TBD	
2	Tray	PET（Transmit）	485X330X13.8	0.167	30	Anti-static
4	Dust-Proof Bag	Dust-Proof Bag	700*545	0.021	1	
5	BOX	CORRUGATED PAPER	520*345*74	0.227	3	
6	Desiccant	Desiccant	45×50	0.0035	6	
7	Carton	CORRUGATED PAPER	544×365×250	1.01	1	
8	Total weight		TBD			
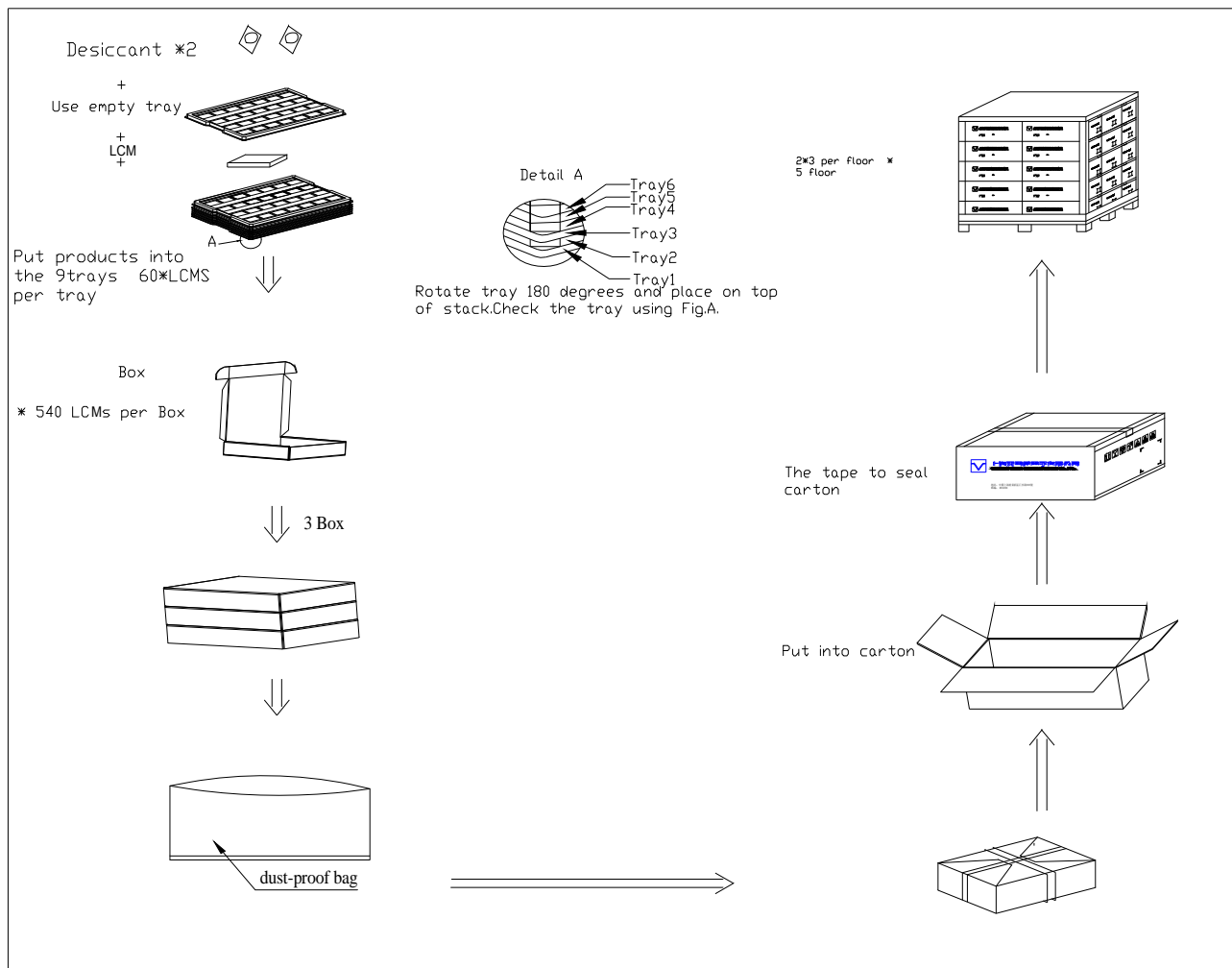
10 Precautions for Use of LCD Modules

11.1 Handling Precautions

11.1.1   The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

11.1.2   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.

11.1.3   Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

11.1.4   The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

11.1.5   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

11.1.6   Do not attempt to disassemble the LCD Module.

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

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

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

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

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

11.1.8.4   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.

11.2 Storage precautions

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

11.2.2   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%

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

11.3 Transportation Precautions:

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