深圳市方九电子科技有限公司

Shenzhen Fangjiu Electronic Technology Co., LTD

Specification

TFT-LCD module

Module(型号):	FJ021B40R01-A
Customer（客户）:	
Customer P/N（客户型号）:	

Approved by（批准）:	
Qualified（合格）:	Unqualified（不合格）:

PREPARED	CHECKED	APPROVED

2.Table of Contents

3.Version Status

REV.NO.	DESCRIPTION	REMARK	DATE
V0	First Release	Original	2019.08.15
V1	Update drawings	Original	2021.01.15

4. General Specifications

FJ021B40R01-A is a color active matrix LCD module incorporating amorphous silicon TFT(Thin Film Transistor). It is composed of a color TFT-LCD panel, driver IC, FPC and a back light unit. The module display area contains 480x480 pixels. This product accords with RoHs environmental criterion.

Item	Content	Unit	Note
LCD Type	TFT	/	
Viewing direction	ALL	O'Clock	
Module outline	Refer to outline drawing	mm	1
Active Area(Φ)	53.28(W)*53.28(H)	mm	
Pixel Size	111	um	
Number of Dots	480 x 480	dots	2
Controller IC	ST7701S	/	
Backlight Typs	4 chips white LEDs	/	
Interface Type	3W SPI + RGB 24bit	/	
F.P.C spec.	0.3	mm	3
Wight	--	g	
Input Voltage	1.8-3.3v	V	
Luminance for LCD	300	Cd/m^2	

Note 1:Refer to the outline drawing,you will find the detailed parameters,including the length,width,thickness

Note 2:Refer the LCD cell Drawing

Note 3:Refer to the outline drawing, Here, can find the size of FPC

5. Absolute Maximum Ratings(Ta=25℃)

Parameter	Symbol	Min	Max	Unit
Power Supply voltage	V_{DD}	-0.3	3.6	V
Logic Signal Input Voltage	V_{DDIO}	-0.3	3.6	V
Operating Temperature	Top	-20	70	℃
Storage Temperature	Tstg	-30	80	℃
High Temp & Hum Operation	60℃ 85%RH,240 hrs			/
Thermal shoc (non-operation)	-30℃(30min)~80℃(30min),50cycle			/

Note . The absolute maximum ratings are the values that must not be exceeded at any time for this product. It is not allowed for any of these ratings to be exceeded.In an extreme case,the product may be permanently destroyed.

6. Electrical Characteristics

6.1 Typical Operation Conditions

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Power supply		V_{DD}	Ta=25℃	2.5	2.8	3.6	V	
Power supply		V_{IOVCC}	Ta=25℃	1.65	1.8	3.3	V	
Input voltage	'H'	V_{IH}	V_{IOVCC} =1.8V	0.7 V_{IOVCC}	-	V_{IOVCC}	V	
	'L'	V_{IL}	V_{IOVCC} =1.8V	0	-	0.3V_{IOVCC}	V	
Current Consumption		I_{CC1}	Normal mode	-	N/A	-	mA	
		I_{CC2}	Sleep mode	-	N/A	-	mA	

6.2 AC Characteristics

6.2.1 Serial Interface command write mode(3-line serial):

The write mode of the interface means the micro controller writes commands and data to the LCD driver. 3-lines serial data packet contains a control bit D/CX and a transmission byte. In 4-lines serial interface, data packet contains just transmission byte and control bit D/CX is transferred by the D/CX pin. If D/CX is “low”, the transmission byte is interpreted as a command byte. If D/CX is “high”, the transmission byte is command register as parameter.

Any instruction can be sent in any order to the driver. The MSB is transmitted first. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or SDA data have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission.

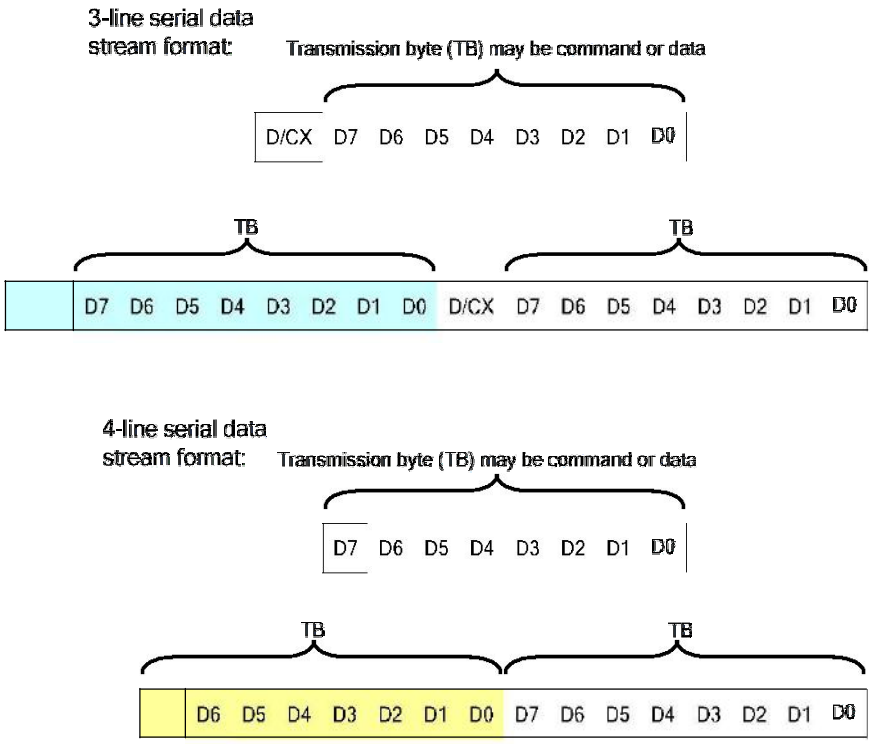


Figure 10 Serial interface data stream format

When CSX is “high”, SCL clock is ignored. During the high period of CSX the serial interface is initialized. At the falling edge of CSX, SCL can be high or low. SDA is sampled at the rising edge of SCL. D/CX indicates whether the byte is command (D/CX=’0’) or parameter data (D/CX=’1’). D/CX is sampled when first rising edge of SCL (3-line serial interface) or 8th rising edge of SCL (4-line serial interface). If CSX stays low after the last bit of command/data byte, the serial interface expects the D/CX bit (3-line serial interface) or D7 (4-line serial interface) of the next byte at the next rising edge of SCL..

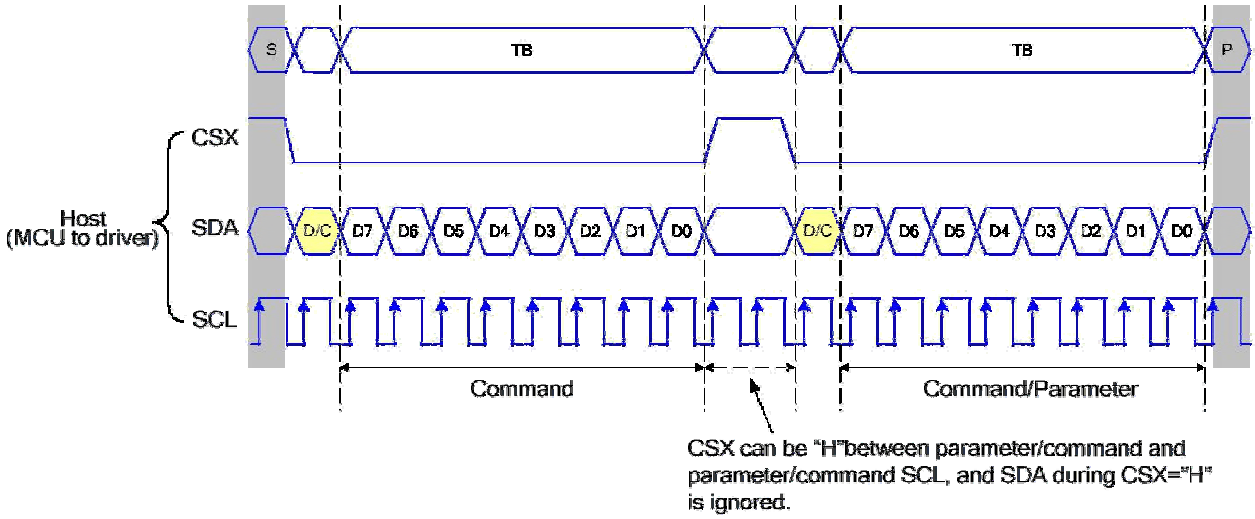


Figure 11 3-line serial interface write protocol (write to register with control bit in transmission)

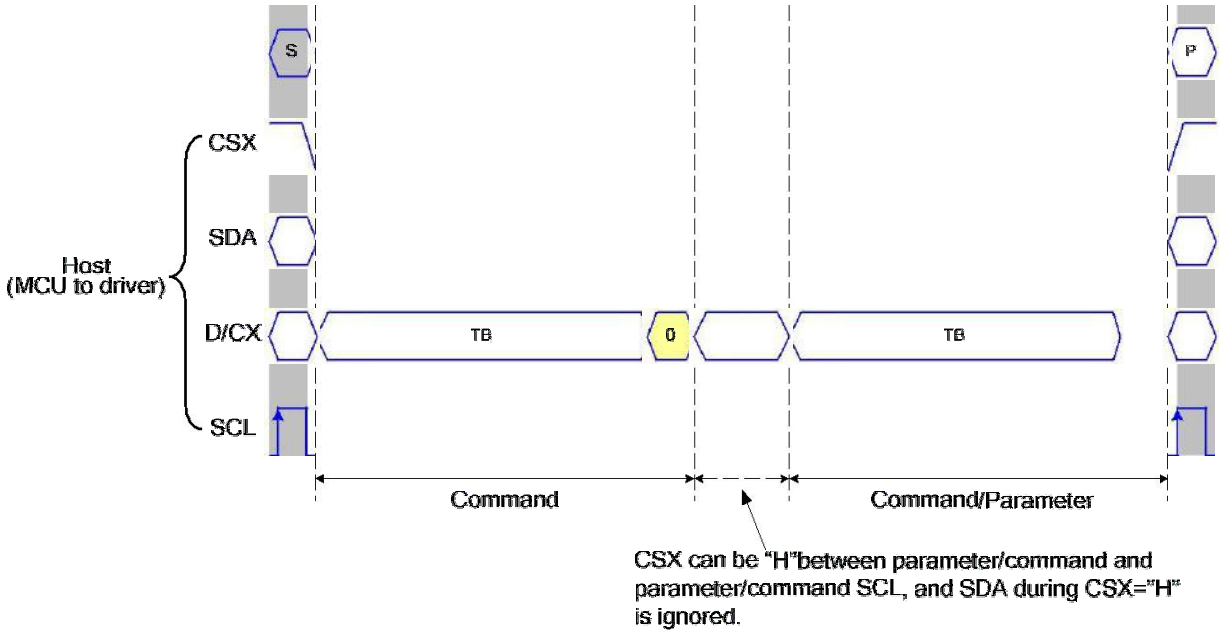


Figure 12 4-line serial interface write protocol (write to register with control bit in transmission)

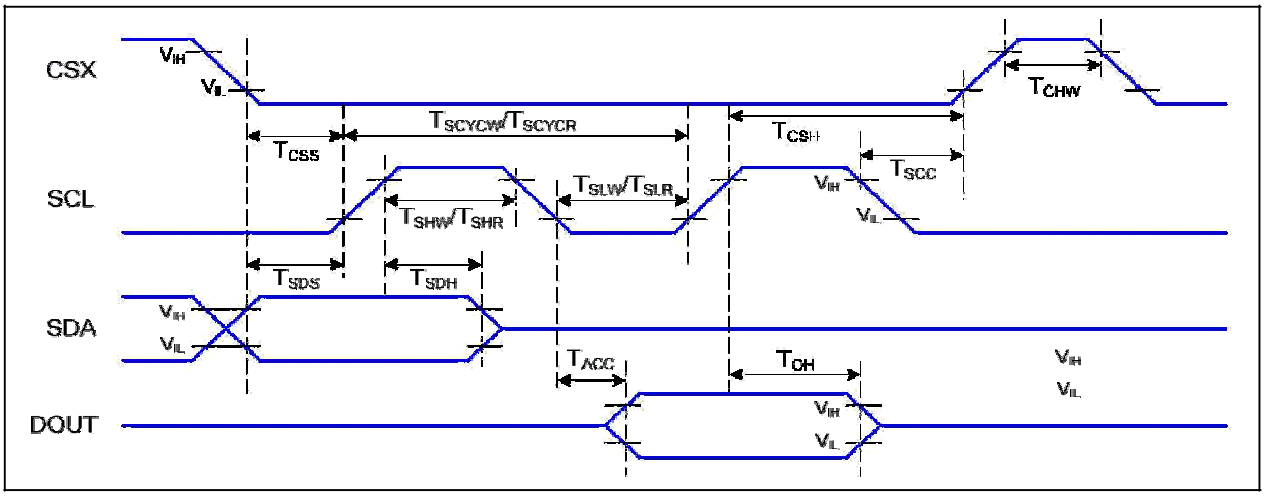


Figure 1 3-line serial Interface Timing Characteristics

VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	CSS	Chip select setup time (write)	15		ns	
	CSH	Chip select hold time (write)	15		ns	
	CSS	Chip select setup time (read)	60		ns	
	SCC	Chip select hold time (read)	60		ns	
	CHW	Chip select “H” pulse width	40		ns	℃
SCL	SCYCW	Serial clock cycle (Write)	66		ns	
	SHW	SCL “H” pulse width (Write)	15		ns	
	SLW	SCL “L” pulse width (Write)	15		ns	
	SCYCR	Serial clock cycle (Read)	150		ns	
	SHR	SCL “H” pulse width (Read)	60		ns	
	SLR	SCL “L” pulse width (Read)	60		ns	
SDA (DIN)	SDS	Data setup time	10		ns	
	SDH	Data hold time	10		ns	

Table 4 3-line serial Interface Characteristics

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

6.2.3 RGB Interface:

The ST7701S support RGB interface Mode 1 and Mode 2. The interface signals as shown in table 6.3.1.

The Mode 1 and Mode 2 function is select by setting in the Command 2, please reference application note.

In RGB Mode 1, writing data to line buffer is done by PCLK and Video Data Bus (D[23:0]), when DE is high state. The external clocks (PCLK, VS and HS) are used for internal displaying clock. So, controller must always transfer PCLK, VS and HS signal to ST7701S.

In RGB Mode 2, back porch of Vsync is defined by VBP[5:0] of RGBPRCTR command. And back porch of Hsync is defined by HBP[5:0] of RGBPRCTR command. Front porch of Vsync is defined by VFP[5:0] of RGBPRCTR command. And front porch of Hsync is defined by HFP[5:0] of RGBPRCTR command.

RGB I/F Mode	PCLK	DE	VS	HS	DB[23:0]	Register for Blanking Porch setting
RGB Mode 1	Used	Used	Used	Used	Used	Not Used
RGB Mode 2	Used	Not Used	Used	Used	Used	Used

Symbol	Name	Description
PCLK	Pixel clock	Pixel clock for capturing pixels at display interface
HS	Horizontal sync	Horizontal synchronization timing signal
VS	Vertical sync	Vertical synchronization timing signal
DE	Data enable	Data enable signal (assertion indicates valid pixels)
DB[23:0]	Pixel data	Pixel data in 16-bit,18-bit and 24-bit format

Table 11 The interface signals of RGB interface

6.2.4 RGB Color Format:

ST7701S supports two kinds of RGB interface, DE mode (mode 1) and HV mode (mode 2), and 16bit/18bit and 24 bit data format. When DE mode is selected and the VSYNC, HSYNC, DOTCLK, DE, D[23:0] pins can be used; when HV mode is selected and the VSYNC, HSYNC, DOTCLK, D[23:0] pins can be used. When using RGB interface, only serial interface can be selected.

Pad name	24 bits configuration VIPF[3:0]=0111	18 bits configuration VIPF[3:0]=0110		16 bits configuration VIPF[3:0]=0101
		MDT=0	MDT=1	
DB[23]	R7	Not used	Not used	Not used
DB[22]	R6	Not used	Not used	Not used
DB[21]	R5	R5	Not used	Not used
DB[20]	R4	R4	Not used	R4
DB[19]	R3	R3	Not used	R3
DB[18]	R2	R2	Not used	R2
DB[17]	R1	R1	R5	R1
DB[16]	R0	R0	R4	R0
DB[15]	G7	Not used	R3	Not used
DB[14]	G6	Not used	R2	Not used
DB[13]	G5	G5	R1	G5
DB[12]	G4	G4	R0	G4
DB[11]	G3	G3	G5	G3
DB[10]	G2	G2	G4	G2
DB[09]	G1	G1	G3	G1
DB[08]	G0	G0	G2	G0
DB[07]	B7	Not used	G1	Not used
DB[06]	B6	Not used	G0	Not used
DB[05]	B5	B5	B5	Not used
DB[04]	B4	B4	B4	B4
DB[03]	B3	B3	B3	B3
DB[02]	B2	B2	B2	B2
DB[01]	B1	B1	B1	B1
DB[00]	B0	B0	B0	B0

Table 12 The interface color mapping of RGB interface

6.2.4 RGB Interface Definition:

The display operation via the RGB interface is synchronized with the VSYNC, HSYNC, and DOTCLK signals. The data can be written only within the specified area with low power consumption by using window address function. The back porch and front porch are used to set the RGB interface timing.

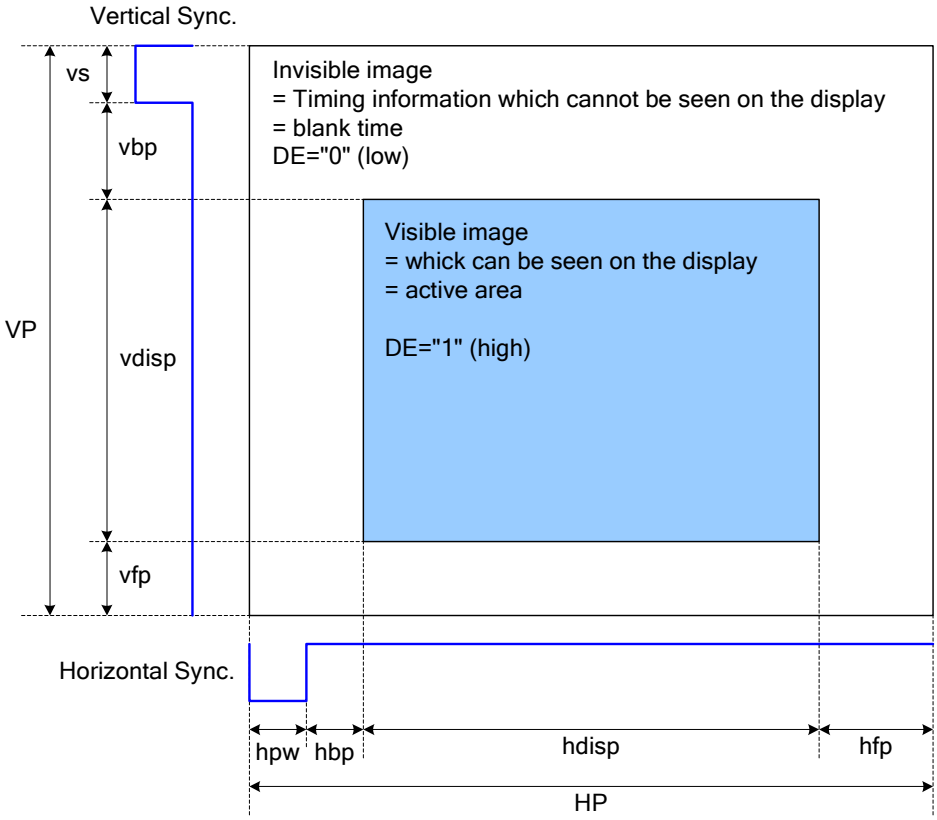


Figure 22 Access Area by RGB Interface

Please refer to the following table for the setting limitation of RGB interface signals.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Horizontal Sync. Width	hpw	1	-	255	Clock
Horizontal Sync. Back Porch	hbp	1	--	255	Clock
Horizontal Sync. Front Porch	hfp	1	--	-	Clock
Vertical Sync. Width	vs	1	--	254	Line
Vertical Sync. Back Porch	vbp	1	--	254	Line
Vertical Sync. Front Porch	vfp	2	--	--	Line

Note:

1. *Typical value are related to the setting frame rate is 60Hz..*

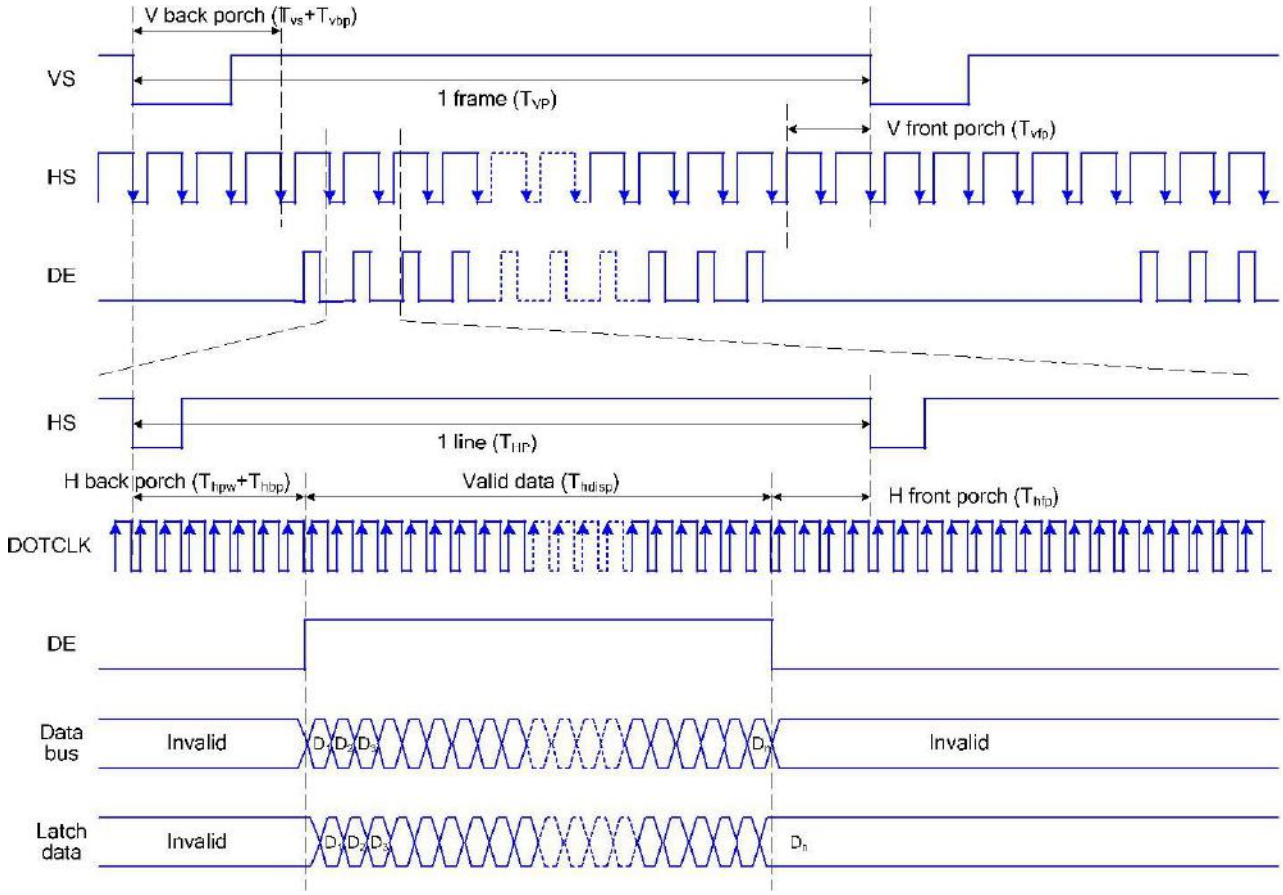
6.2.4 RGB Interface Mode Selection:

ST7701S supports two kinds of RGB interface, DE mode and HV mode. The table shown below uses command C3h to select RGB interface mode.

DE/Sync	RGB Mode
0	DE mode
1	HV mode

8.6.4 RGB Interface Timing

The timing chart of RGB interface DE mode is shown as follows.



Note: The setting of front porch and back porch in host must match that in IC as this mode.

Figure 23 Timing Chart of Signals in RGB Interface DE Mode

The timing chart of RGB interface HV mode is shown as follows.

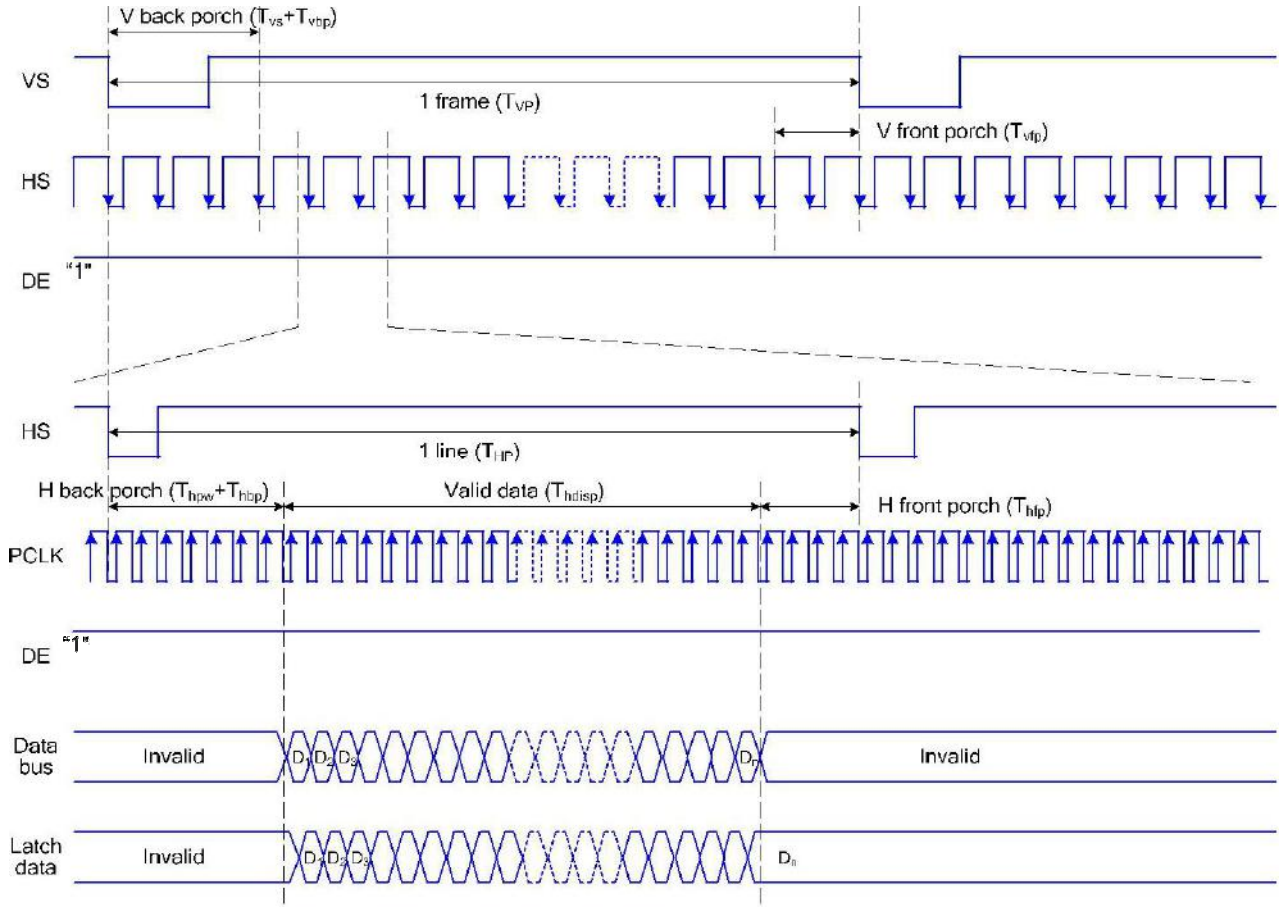


Figure 24 Timing chart of RGB interface HV mod

6.2.3 RGB Interface Characteristics:

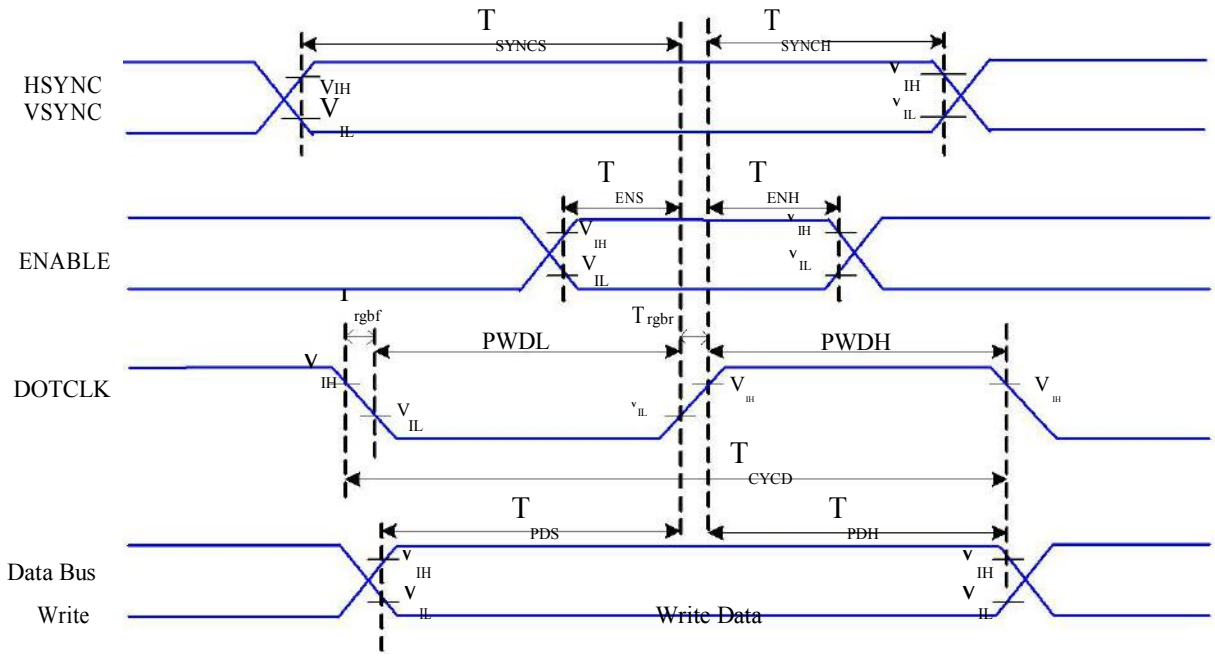


Figure 3 RGB Interface Timing Characteristics

VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T_{SYNCS}	VSYNC, HSYNC Setup Time	5	-	ns	
ENABLE	T_{ENS}	Enable Setup Time	5	-	ns	°C
	T_{ENH}	Enable Hold Time	5	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	15	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	15	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	33	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	15	ns	
DB	T_{PDS}	PD Data Setup Time	5	-	ns	
	T_{PDH}	PD Data Hold Time	5	-	ns	

Table 6 18/16 Bits RGB Interface Timing Characteristics

7.Backlight Characteristics

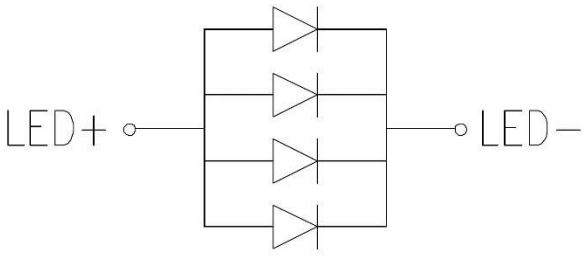
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Forward voltage	Vf	I_f=80mA	2.8	3.2	3.3	V	
Forward current	I_{Led}	-		20	25	mA	
Number of LED	--	--		4		pcs	
Life Time	--	--	10000	20000	--	Hrs	Note3
Connection mode	P	--	4 Parallel			--	

Note 1: I_f is defined for one channel LED. There are total four LED channels in back light unit

Note 2: Optical performance should be evaluated at Ta=25℃ only.

Note 3: I_f 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.



8. Interface Pin Connections

PIN.No	Symbol	Function
1	LED-	Backlight LED Ground
2	LED+	Backlight LED Power
3	GND	Ground
4	VDD	Power supply
5-12	R0-R7	Red Data
13-20	G0-G7	Green Data
21-28	B0-B7	Blue Data
29	GND	Ground
30	PCLK	Clock Signal
31	NC	No connect
32	HSYNC	Horizontal sync input in RGB mode
33	VSYNC	Vertical sync input in RGB mode
34	DEN	Data Enable
35	NC	No connect
36	GND	Ground
37	Reset	The external reset input;Initializes the LCM with a low input.
38	SDI	Serial data input/output bidirectional pin for SPI interface.
39	SCL	Serial clock input for SPI interface
40	CS	LCM select signal;Low-accessible;High-not accessible

9. Optical Characteristics

Item		Symbol		Condition	Min	Typ	Max	Unit	Note
Brightness		Bp		θ=0°,Φ=0°	--	300	--	Cd/m^2	2
Contrast Ratio		CR			800	1000	--	--	3
Response Time		Tr+Tf		θ=0°,Φ=0°	--	30	35	ms	4
Viewing Angle	Vertical	U	--	CR≥10	80	85	--	Deg	5
		D	--		80	85	--		
	Horizonta	L	--		80	85	--	Deg	
		R	--		80	85	--		
Color Filter Chroma-cicity		*If need more information pls contact JustDo Electronic.*							

Note：The parameter is slightly changed by temperature, driving voltage and materiel

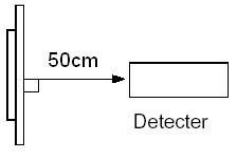
Note 1. Ambient condition：**25℃±2℃**，60±10%RH，under 10 Lunx in the darkroom

Note 2. The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value. Measurement equipment BM-7(TOPCON) (Φ8mm)

Measuring condition:

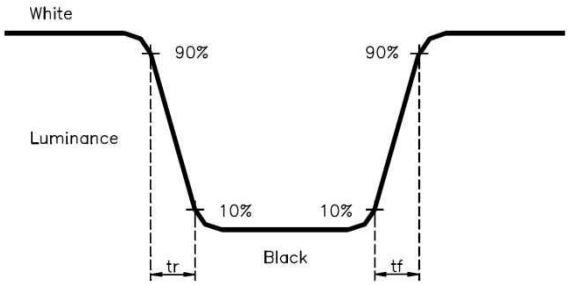
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on

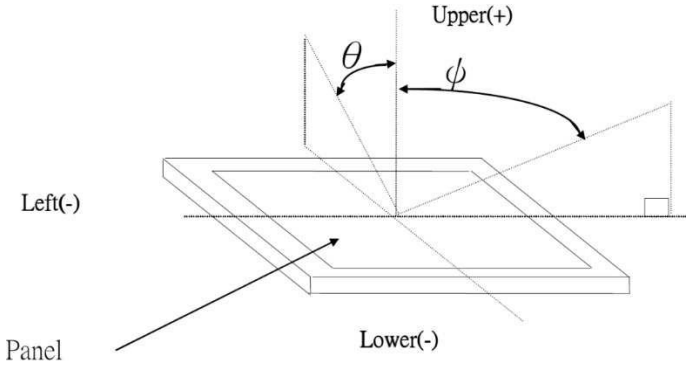


Note 3.Definition of Contrast Ratio: CR=White Luminance(ON)/Black Luminance(OFF)

Note 4.Definition of response time: The response time is defined as the time interval between the 10% and 90% amplitudes.



Note 5.Definition of view angle(θ,Φ)



10. Reliability Test Items and Criteria

No	Test Item	Test Condition	Criterion
1	High Temperature Storage	80℃;240hrs	1. After testing, cosmetic and electrical defects should not happen. 2. Total current consumption should not be more than twice of initial value.
2	Low Temperature Storage	-30℃;240hrs	
3	High Temperature Operation	70℃;240hrs	
4	Low Temperature Operation	-20℃;240hrs	
5	Hight Temperature and High Humidity Operation	60℃,90%RH;240hrs	
6	Thermal Shock	-30℃+80℃,0.5Hr;200cycles	
7	Vibration Test	10Hz~150Hz,100m/s²,120min	Not allowed cosmetic and electrical defects.
8	Shock Test	Half-sine wave,300m/s²,11ms	

NOTE

1. All judgement of display are performed after temperature of panel return to room temperature.
2. Display function should be no change under normal operating condition.
3. Under no condensation of dew.
4. JustDo Electronic only guarantee the above 5 test items, and without guarantee the others.

11. Inspection Certeria

11.1 Classification of defects

Major defects (MA): A major defect refers to a defect that may substantially degrade usability for product applications, including all functional defects(such as no display, abnormal display, open or missing segment, short circuit, missing component), outline dimension beyond the drawing, progressive defects and those affecting reliability.

Minor defects (MI): A minor defect refers to a defect which is not considered to be able to substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation, such as black spot, white spot, bright spot, pinhole, black line, white line, contrast variation, glass defect, polarizer defect, etc.

11.2 Definition of inspection range

For dot defect of TFT LCD which is not smaller than 3 inches, dividing three areas to make a judgment (according to figure 1).

A area : center of viewing area

B area : periphery of viewing area

C area : Outside viewing area

For other defects, dividing two areas to make a judgment (according figure 2).

A zone : Inside Viewing area

B zone : Outside Viewing area

X1(A.A~V.A): 2mm X2(A.A~V.A): 2mm

Y1(A.A~V.A): 2mm Y2(A.A~V.A): 2mm

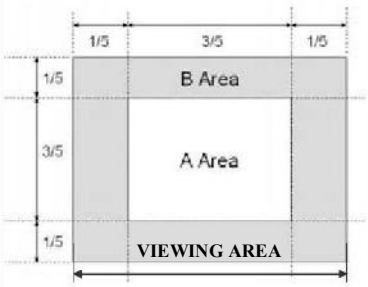


Figure 1

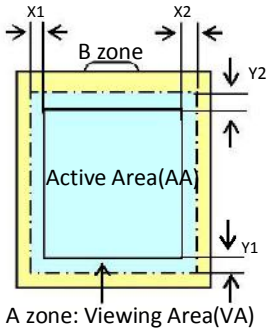


Figure 2

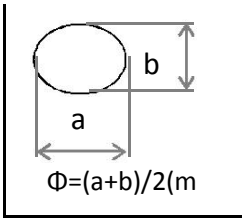
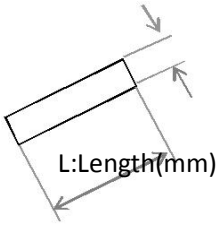
11.3 Inspection items and general notes

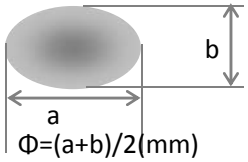
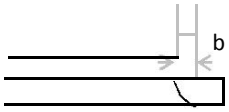
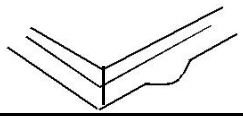
General notes	Should any defects which are not specified in this standard happen, additional standard shall be determined by mutual agreement between customer and JustDo Electronic. Viewing area should be the area which JustDo Electronic guarantees. Limit sample should be prior to this Inspection standard. Viewing judgment should be under static pattern. Inspection conditions Inspection distance: 250 mm (from the sample) Temperature : 25±5 ºC Inspection angle : 45 degrees in 6 o'clock direction (all defects in viewing area should be inspected from this direction)	
Inspection items	Pinhole, Bright spot, Black spot, White spot, Black line, White Line, Foreign particle, Bubble	The color of a small area is different from the remainder. The phenomenon doesn't change with voltage
	Contrast variation	The color of a small area is different from the remainder. The phenomenon changes with voltage
	Polarizer defect	Scratch, Dirt, Particle, Bubble on polarizer or between polarizer and glass
	Dot defect (TFT LCD)	The pixel appears bright or dark abnormally when display
	Functional defect	No display, Abnormal display, Open or missing segment, Short circuit, False viewing direction
	Glass defect	Glass crack, Shaved corner of glass, Surplus glass
	PCB defect	Components assembly defect

11.4 Outgoing Inspection level

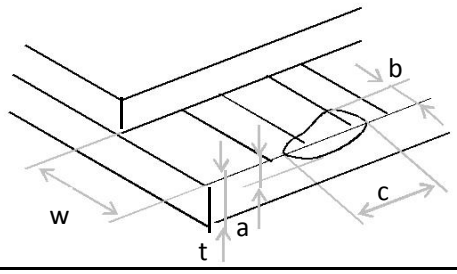
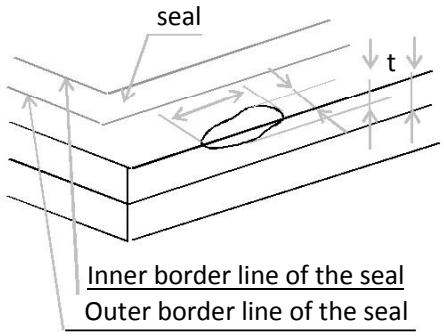
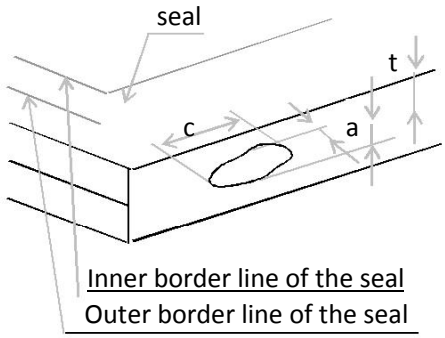
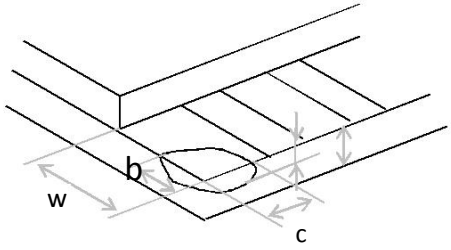
Outgoing Inspection standard	Inspection conditions	Inspection				
		Min.	Max.	Unit	IL	AQL
Outline Dimension	See 13: Outline Drawing	See 13			II	0.065
Position finding Dimension Assemble Dimension	See 13: Outline Drawing	See 13			II	0.065
Note：Sampling standard conforms to GB2828						

11.5 Inspection Items and Criteria

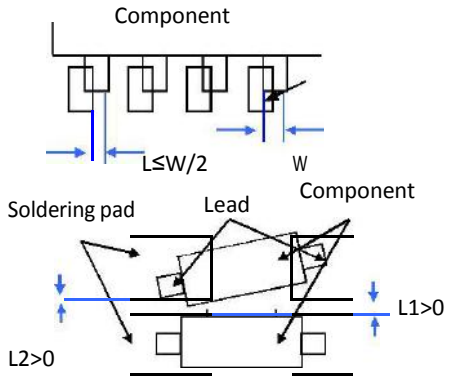
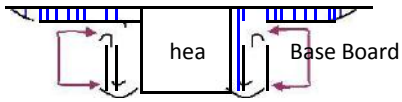
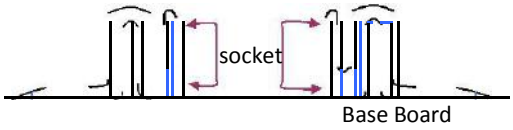
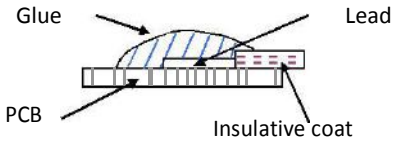
Inspection items			Judgment standard			
			Category		Acceptable number	
					A zone	B zone
1	Black spot, White spot, Pinhole, Foreign Particle, Particle in or on glass, Scratch on glass		A	Φ<=0.10	Neglected	Neglected
			B	0.10<Φ<=0.2	1	
			C	0.2<Φ	0	
			D	-	-	
			Total defective point(B,C)		1	
2	Black line, White line, and Particle Between Polarizer and glass, Scratch on glass		A	W<=0.02	Neglected	Neglected
			B	0.02<W<=0.03 L<=1.0	1	
			C	0.03<W<=0.05 L>1.0	0	
			D	0.05<W, 1.0<L	0	
			Total defective point(B,C)		1	
3	Bright spot		any size		none	none
4	Contrast variation		A	Φ<0.2	Neglected	Neglected
			B	0.2<Φ<=0.3	2	

			C	0.3<Φ<=0.4	1	
			D	0.4<Φ	0	
			Total defective point(B,C)		3	
5	Bubble inside cell		any size		none	none
6	Polarizer defect (if Polarizer is used)	Scratch ,damage on polarizer, Particle on polarizer or between polarizer and glass.	Refer to item 1 and item 2.			
		Bubble, dent and convex	A	Φ<=0.1	Neglected	Neglected
			B	0.1 <Φ<=0.2	1	
			C	0.2 <Φ	0	
7	Surplus glass	Stage surplus glass 	B<=0.3mm			
		Surrounding surplus glass 	Should not influence outline dimension and assembling.			
8	Open segment or open common		Not permitted			
9	Short circuit		Not permitted			
10	False viewing direction		Not permitted			
11	Contrast ratio uneven		According to the limit specimen			
12	Crosstalk		According to the limit specimen			
13	Black /White spot(display)		Refer to item 1			
14	Black /White line(display)		Refer to item 2			

Inspection items	Judgment standard	
	Category(application: B zone)	Acceptable number

<table>
<tr><td rowspan="4">15</td><td rowspan="4">Glass defect crack</td><td>i)The front of lead terminals
  </td><td>A</td><td>a≤ t, b≤1/5W, c≤3mm</td><td rowspan="4">Max.3 defects allowed</td></tr>
<tr><td></td><td>B</td><td>Crack at two sides of lead terminals should not cover patterns and alignment mark</td></tr>
<tr><td>ii)Surrounding crack-non-contact side
  </td><td colspan="2">b < Inner borderline of the seal</td></tr>
<tr><td>iii) Surrounding crack- contact side
  </td><td colspan="2">b < Outer borderline of the seal</td></tr>
<tr><td rowspan="2">iv)Corner
  </td><td>A</td><td>a <= t, b <= 3.0, c <= 3.0</td><td rowspan="2"></td></tr>
<tr><td>B</td><td>Glass crack should not cover patterns u and alignment mark and patterns.</td></tr>
</table>

Inspection items	Judgment standard
	Category(application: B zone)

16	PCB defect	Component soldering: No cold soldering、short、open circuit、burr、tin ball The flat encapsulation component position deviation must be less than 1/3 width of the pin (Pic.1)； the sheet component deviation: Pin deviates from the pad and contact with the near components is not permitted （Pic.2）	
		lead defect: The lead lack must be less than 1/3 of its width; The lead burr must be less than 1/3 of the seam; Impurities connect with the near leads is not permitted	
		Connector soldering: Soldering tin is at contact position of the plug and socket is not permitted No foundation is scald Serious cave distortion on plug and socket contact pin is not permitted	 Soldering tin is not permit in this area Soldering tin is not permit in this area 
		Glue on root of the speaker receiver and motor lead: The insulative coat of the lead must join into the PCB; the protected glue must envelop to the insulative coat.	

12. Precautions for Use of LCD Modules

12.1 Handling Precautions

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

12.1.2 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.

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

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

12.1.5 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

12.1.6 Do not attempt to disassemble the LCD Module.

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

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

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

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

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

d. 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.

12.2 Storage precautions

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

12.2.2 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℃ ~ 35℃

Relatively humidity: ≤80%

REMARK: If the LCD modules is covered with Touch Panel, in order to ensure the effectiveness of the protective film, its storage conditions are more harsh, the recommend condition is:

Temperature : 20±5℃

Relatively humidity: 60%±10%RH

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

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

13. Outline Drawing