TITLE: TPA042-001V01
Product Specification

ITEM	SIGNATURE	ITEM	SIGNATURE		
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Beijing BOE Special Display Technology CO.,LTD

BOE	**PRODUCT GROUP**		SR100420101	
	TFT LCD		Rev.2	2018.7.11

CONTENT LIST

Records Of Revisions				
Revision	Date	Page	Description	Released by
Rev.0	2017.7.11		Initial Released	Chenxiaojiao
Rev.1	2018.4.26	10	Electrical Interface Update	Zhaokening
Rev.2	2018.7.11	7~12	3.2~3.4章节内容移动到第6章	Zhaokening

1.0 GENERAL DESCRIPTION

1.1 Introduction

4.2" 480×480 is a color active matrix TFT-LCD model using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This model is composed of a TFT-LCD Panel and a driving circuit. It is a transmissive type display operating in the normal black. This TFT-LCD has a 4.2 inch diagonally measured active area with 480×480 resolutions (480 horizontal by 480 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in 2 domain stripe and this panel can display 16.7M colors.
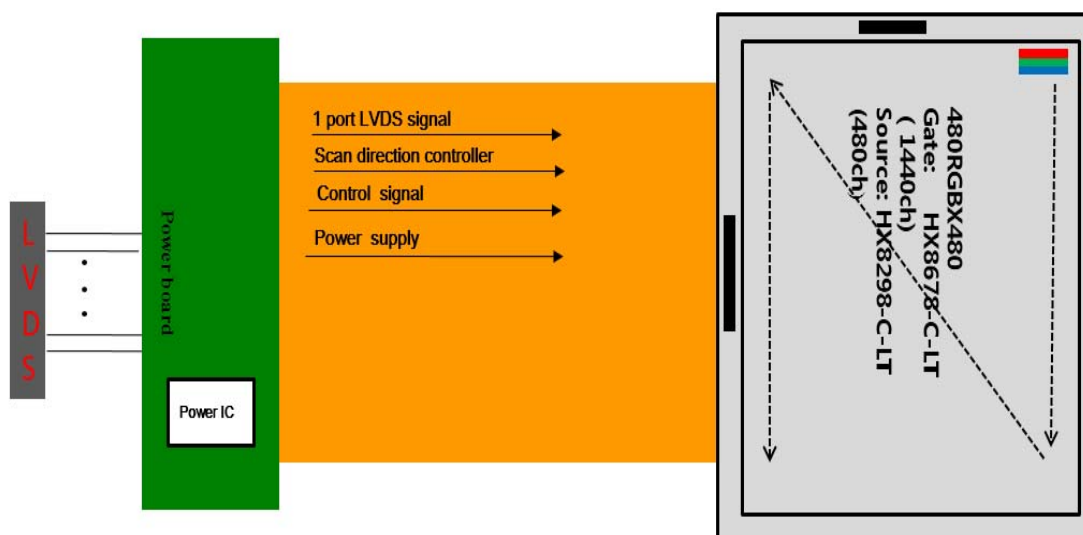
1.2 Features

- 0.5t Glass (Single)

- Wide operating temperature

- FOG Design

- Display 16.7M colors

- High contrast ratio, wide viewing angle

1.3 General Specifications (H: horizontal length, V: vertical length)

Parameter	Specification	Unit	Remark
Active Area	76.32(H) × 76.32(V)	mm	
Number of Pixels	480(H)RGB × 480(V)	pixels	
Pixel Pitch	159(H) × 159(V)	um	
Pixel Arrangement	RGB 2 domain stripe		
Display Colors	16.7M	colors	
Color Gamut	72%		Typ
Display Mode	Normally black, Transmissive mode		
Dimensional Outline	85(H)×87 (V)×1.245 (D)	mm	w/o PCBA
Viewing Direction (Human Eye)	U/D/L/R free viewing direction		Note1
Weight	25(max.)	g	Open cell
Surface Treatment	HC		

Note:

1. At the U/D/L/R direction, the viewing angle is same.

2.0 Absolute Maximum Ratings

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. Make sure all the design characteristics are adequate before the panel is initialed. All the measurements should be operated with driver IC and experimental FPC mounted.

[VSS = GND = 0V]

Parameter	Symbol	Min	Max	Unit	Remark
Operating Voltage	V_{op}	3.0	3.6	V	Ta = 25℃
Operating Temperature	T_{OP}	-40	+85	℃	
Storage Temperature	T_{ST}	-55	+85	℃	
Operating Ambient Humidity	Hop	20	80	%RH	*1)
Storage Humidity	Hst	20	80	%RH	*1)

Note：

*1) Temp≤40℃ 90% RH MAX.

3.0 ELECTRICAL SPECIFICATION

Recommend Parameters for Electrical Characteristics

Parameter	Symbol	Value	Unit	Remark
		Reference		
TFT Gate ON Voltage	VGH	10~15	V	Note1
TFT Gate OFF Voltage	VGL	-13~-7	V	Note2
TFT Common Electrode Voltage	VCOM	-2~1	V	Note3
TFT Kick-Back Voltage Max	ΔVp Max	1.1~1.7	V	
TFT Kick-Back Voltage Min	ΔVp Min	1.0~1.6	V	

Note:

1. V_{GH} is TFT Gate operating voltage.

2. V_{GL} is TFT Gate operating voltage. The low voltage level of V_{GL} signal must be fluctuate with same phase as V_{com}, the storage capacitance structure of the product is storage on common.

3. V_{com} must be adjusted to optimize display quality, as Crosstalk and Contrast Ratio etc.,

We just kindly recommend the setting-voltages the reference value.

In order to get the optimized display quality, the setting-voltage should be changed according to customer's developing condition. (The display quality could be changed by customer's setting –voltage.)

4.0 OPTICAL SPECIFICATIONS

4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance≤ 1 lux and temperature = 25±2℃) with the equipment of Luminance meter system (Topcon SR-UL1R and Westar TRD-100A) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°.The center of the measuring spot on the Display surface shall stay fixed.

The backlight should be operating for 30 minutes prior to measurement.

4.2 Optical Specifications

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle	Horizontal	Θ3	CR>10	85	-	-	°	Note 1
		Θ9		85	-	-	°	
	Vertical	Θ12		85	-	-	°	
		Θ6		85	-	-	°	
Contrast Ratio		CR	Θ= 0°	800	1000	-	-	Note 2
Transmittance		T(%)	Θ= 0°	4.0	4.4	-	-	Note 3
NSTC(CIE1976)		%	Θ= 0°	68	72	-	-	
Reproduction Of color (CIE1976)	Red	Ru'	Θ= 0°	0.4383	0.4533	0.4683		Note 4 Color filter Glass with OC (By Backlight of BOE)
		Rv'		0.5075	0.5225	0.5375		
	Green	Gu'		0.0994	0.1144	0.1294		
		Gv'		0.5447	0.5597	0.5747		
	Blue	Bu'		0.143	0.1580	0.173		
		Bv'		0.1794	0.1944	0.2094		
White		Wu'	Θ= 0°	0.1664	0.1814	0.1964		
		Wv'		0.4387	0.4537	0.4687		
Response Time		Tr+Tf	Θ= 0°	-	-	30	ms	Note 5
Cross talk		-		-	-	2%		Fig.3

Note:

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see FIG.1). Viewing angle measuring is based on WV Pol attached.

2. Contrast measurements shall be made at viewing angle of Θ= 0° and at the center of the LCD surface.

Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See FIG.1) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Transmittance is the value with Polarizer.

4. The color chromaticity coordinates specified in Table1 shall be calculated from The spectral data measured with all pixels first in red, green, blue and white.
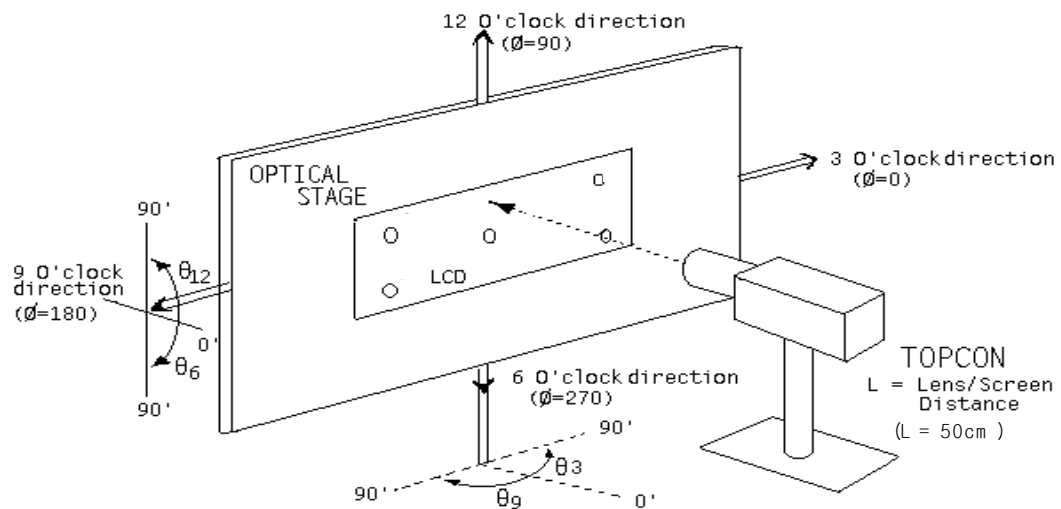
Measurements shall be made at the center of the C/F.

Measurement condition is C - light source & Halogen Lamp

5. The electro-optical response time measurements shall be made as FIG.2 by switching the "data" input signal ON and OFF.

The times needed for the luminance to change from 10% to 90% is Tf, and 90% to 10% is Tr.

Figure 1. Measurement Set Up
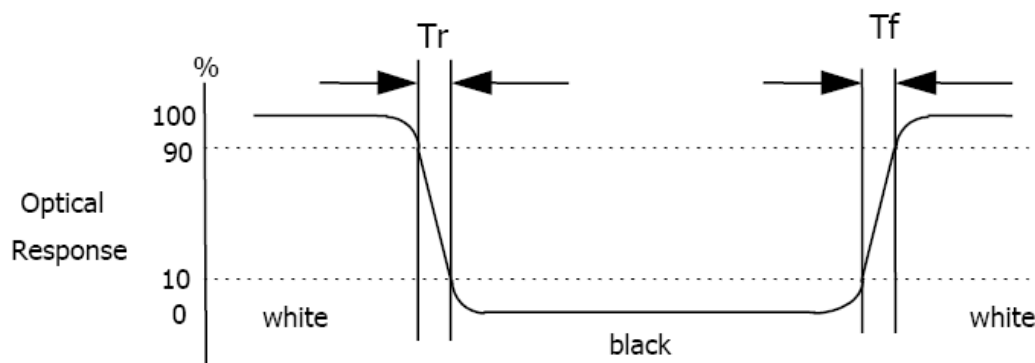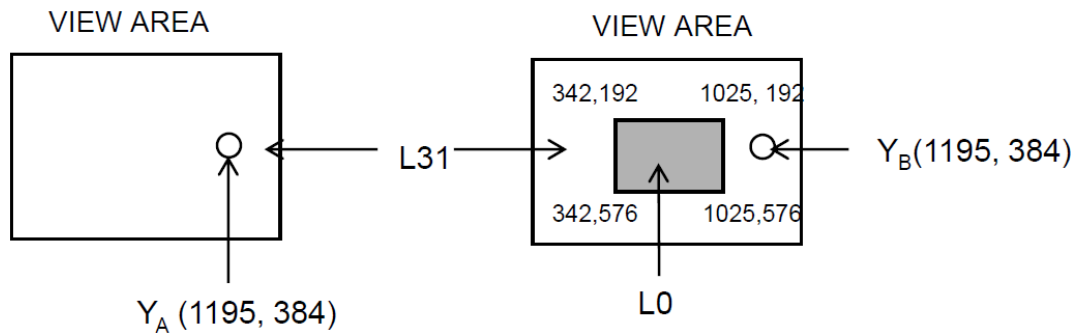

Figure 2. Response Time Testing

Figure 3. Cross Modulation Test Description

VIEW AREA   VIEW AREA

342,192   1025, 192

L31

342,576   1025,576

Y_A (1195, 384)   L0 Y_B(1195, 384)

$$\text{Cross-Talk (\%)} = \left| \frac{Y_B - Y_A}{Y_A} \right| \times 100$$

Where:

Y_A = Initial luminance of measured area (cd/m^2)
Y_B = Subsequent luminance of measured area (cd/m^2)
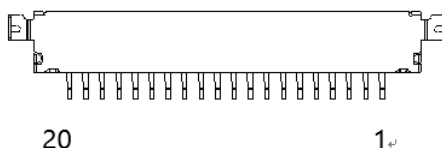The location measured will be exactly the same in both patterns

5.0 INTERFACE CONNECTION

5.1 Electrical Interface Connection

The electronics interface connector is JAE FI-SE20P-HFE or Compatible.

The connector interface pin assignments are listed as follow.

Figure 4. LVDS Interface （unit: mm if unspecified）

| No.	Symbol	Functions
20	VCC	Power supply 3.3V
19	VCC	Power supply 3.3V
18	GND	Ground
17	GND	Ground
16	D0-	Transmission Data of 0-
15	D0+	Transmission Data of 0+
14	GND	Ground
13	D1-	Transmission Data of 1-
12	D1+	Transmission Data of 1+
11	GND	Ground
10	D2-	Transmission Data of 2-
9	D2+	Transmission Data of 2+
8	GND	Ground
7	CLK-	Transmission Clock-
6	CLK+	Transmission Clock+
5	GND	Ground
4	D3-	Transmission Data of 3-
3	D3+	Transmission Data of 3+
2	GND	Ground
1	DPS	NC

5.2 LVDS Input signal mapping
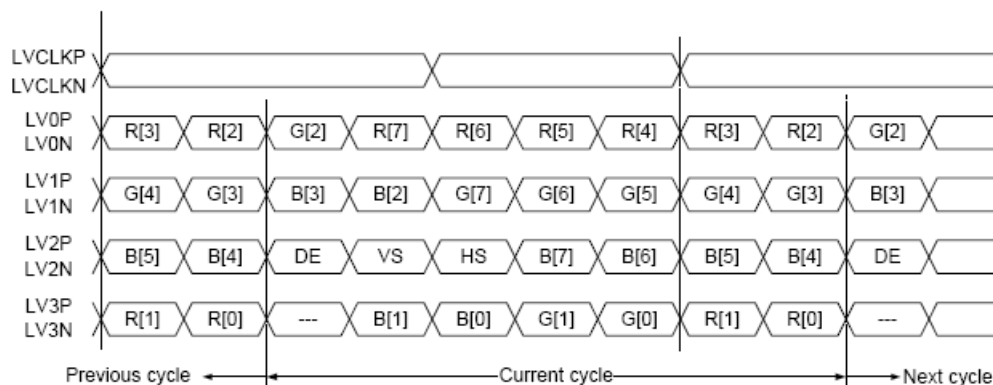
5.3 LVDS Input signal
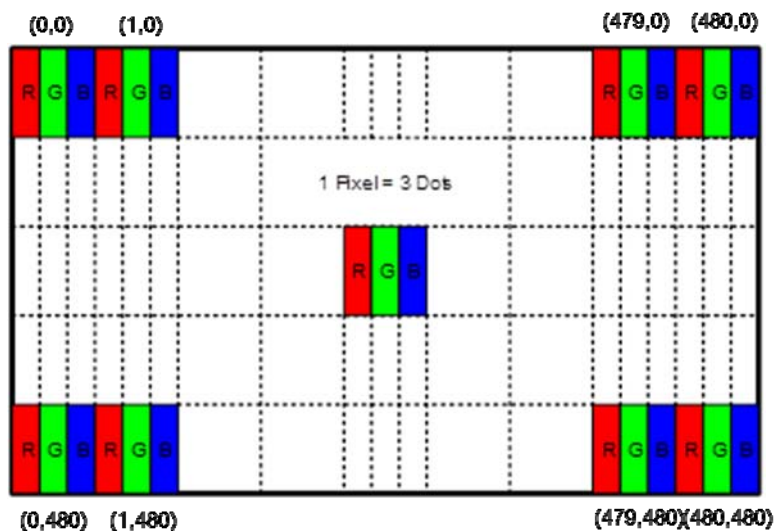
Display Position of Input Data（V-H）

## 6.0 SIGNAL TIMING SPECIFICATION

6.1 Timing Parameters

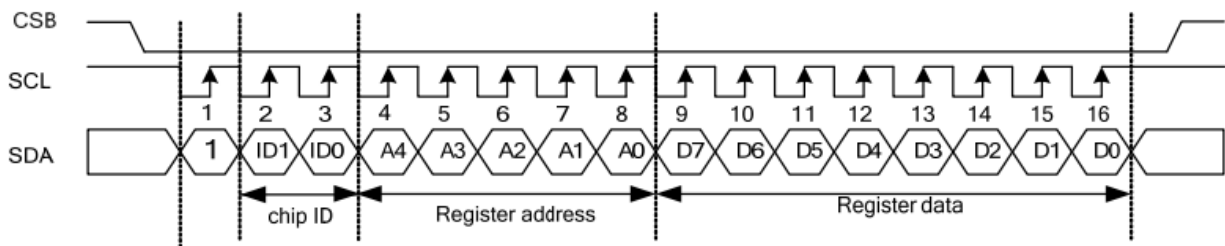| parameter	symble	480xRGBx480			Unit
		Min	Typ	Max	
DCLK Frepuence	FDCLK	-	16.22	-	MHz
Horizontal valid data	thd		480		DCLK
Hsync Pulse Width	thpw	6	8	20	DCLK
Hsync back porch	thbp	10	8	20	DCLK
Hsync front porch	thfp	8	16	28	DCLK
1 Horizontal Line	th	504	512	556	DCLK
Vertical valid data	tvd		480		H
Vsync Pulse Width	tvpw	6	2	20	H
Vsync back porch	tvbp	3	3	13	H
Vsync front porch	tvfp	5	43	15	H
1 Vertical Line	tv	494	528	528	H
Frame rate	fr	50	60	65	Hz

6.2 Timing diagrams of interface signal
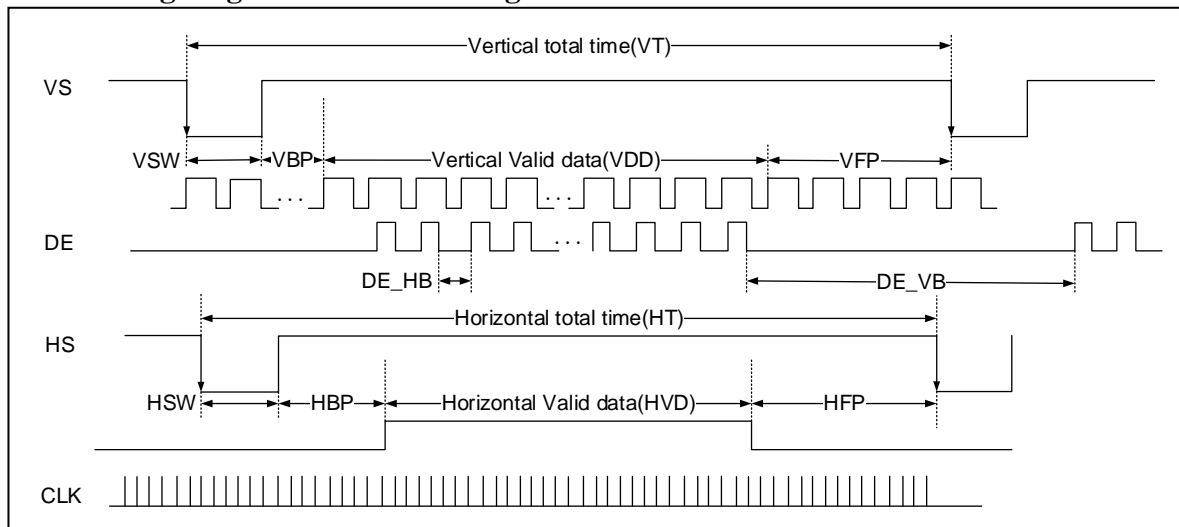
6.3 SPI read/write mode

When SPI at write mode, the read/write control bit must be setting "L". And SDA is address and data input pin.
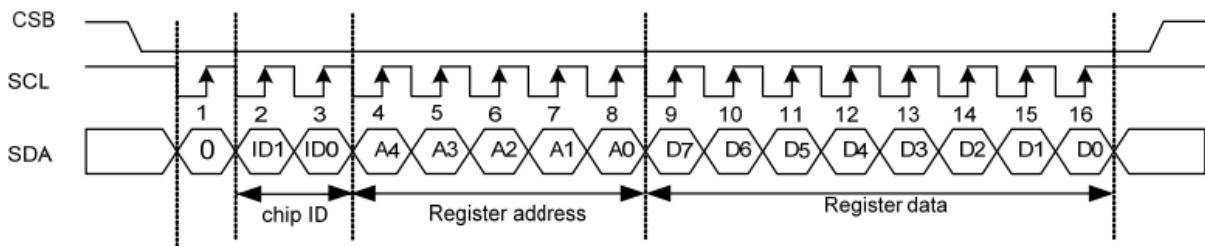
When SPI at read mode, the read/write control bit must be setting "H". And SDA is address and data input pin.

7.0 Input Signals Display Colors & Gray Scale of Colors

Color & Gray Scale		Red Data R7 R6 R5 R4 R3 R2 R1 R0	Green Data G7 G6 G5 G4 G3 G2 G1 G0	Blue Data B7 B6 B5 B4 B3 B2 B1 B0
Basic Colors	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	Blue	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1
	Green	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0
	Cyan	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1
	Red	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	Magenta	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1
	Yellow	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0
	White	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1
Gray Scale of Red	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	△	0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	Darker	0 0 0 0 0 0 1 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	△	↑	↑	↑
	▽	↓	↓	↓
	Brighter	1 1 1 1 1 1 0 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	▽	1 1 1 1 1 1 1 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	Red	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
Gray Scale of Green	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	△	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0
	Darker	0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 0	0 0 0 0 0 0 0 0
	△	↑	↑	↑
	▽	↓	↓	↓
	Brighter	0 0 0 0 0 0 0 0	1 1 1 1 1 1 0 1	0 0 0 0 0 0 0 0
	▽	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 0	0 0 0 0 0 0 0 0
	Green	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0
Gray Scale of Blue	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	△	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1
	Darker	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 0
	△	↑	↑	↑
	▽	↓	↓	↓
	Brighter	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 0 1
	▽	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 0
	Blue	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1
Gray Scale of White	Black	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
	△	0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 1
	Darker	0 0 0 0 0 0 1 0	0 0 0 0 0 0 1 0	0 0 0 0 0 0 1 0
	△	↑	↑	↑
	▽	↓	↓	↓
	Brighter	1 1 1 1 1 1 0 1	1 1 1 1 1 1 0 1	1 1 1 1 1 1 0 1
	▽	1 1 1 1 1 1 1 0	1 1 1 1 1 1 1 0	1 1 1 1 1 1 1 0
	White	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1

Note: 0:Low Level Voltage, 1:High Level Voltage

8.0 Power Sequence

To prevent a latch-up or DC operation of the Open Cell, the power on/off sequence shall be as shown in below.
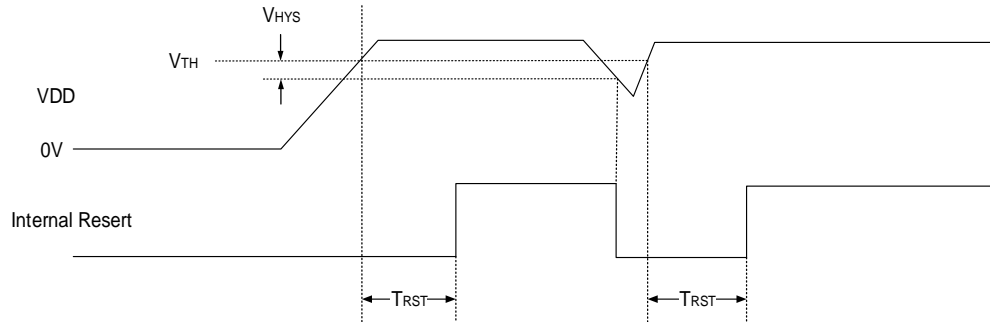
Symbol	Parameter	Condition	Spec			Unit
			Min	Typ	Max	
V_{TH}	Reset threshold voltage	-	1.7	1.9	2.1	V
V_{HYS}	Hysteresis voltage	-	200	-	-	mV
T_{RST}	Time constant of RC	-	-	0.8RC	-	s

9.0 Mechanical Characteristics

9.1 Dimensional Requirements

| Parameter	Specification	Unit	Remark
Panel size	85(H) X 87(V)	mm	
CF size	82.53(H) X83(V)	mm	
Active area	76.32(H) × 76.32(V)	mm	
Number of pixels	480 (H) RGB×480(V)	pixels	
	(1 pixel = R + G + B dots)		
Pixel pitch	159(H) × 159(V)	um	
Pixel arrangement	RGB 2 domain stripe		
Dimensional outline	85(H) X 87(V)×1.245 (D)	mm	OC
Display mode	Normally Black		

9.2 Mounting

See FIG.5.

9.3 Glare and Polarizer Hardness

The surface of the LCD has a hard coating to reduce scratching.

Figure 5. Open Cell Outline Dimensions（unit: mm if unspecified）
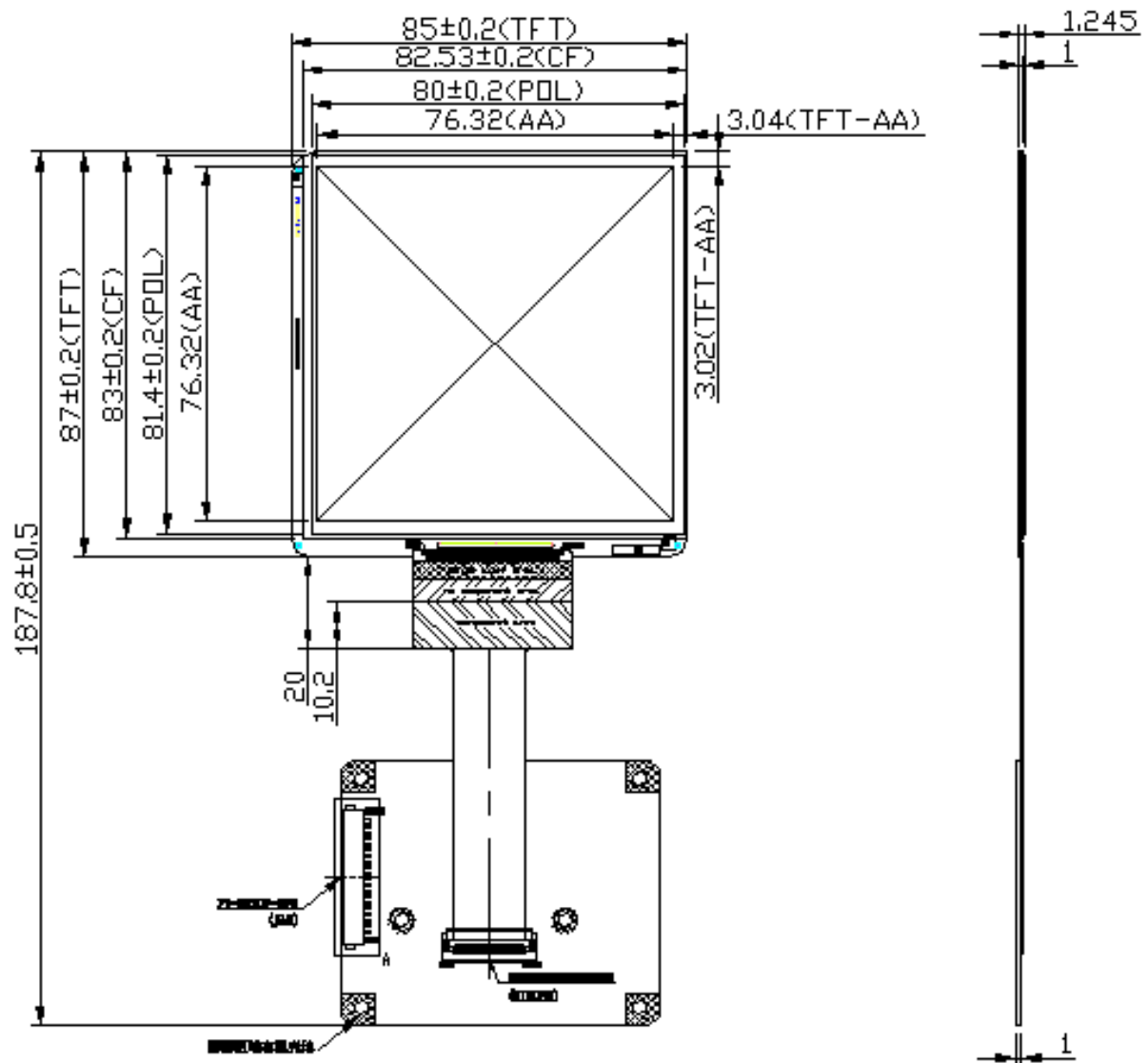
10.0 RELIABILITY TEST

NO	Test Item	Test Condition	Duration
1	Low temperature storage test(LTS)	-55℃	24hrs
	Low temperature operation test(LTO)	-40 ℃	2hrs
	High temperature storage test(HTS)	85 ℃	48hrs
	High temperature operation test(HTO)	85 ℃	2hrs
2	Thermal shock test (TST)	85 ℃：hold for 0.5hr -55 ℃：hold for 0.5hr	10 cycles
	High temperature, high humidity storage test(THS)	30℃～60℃, 95%	240hrs
3	High temperature operation test(HTO)	85 ℃	240hrs

11.0 PACKING

11.1 Tray

The outline of tray is 450mm*370mm, as is shown in Fig6. Package four products with antistatic spacers and trays with the method shown in Fig7.
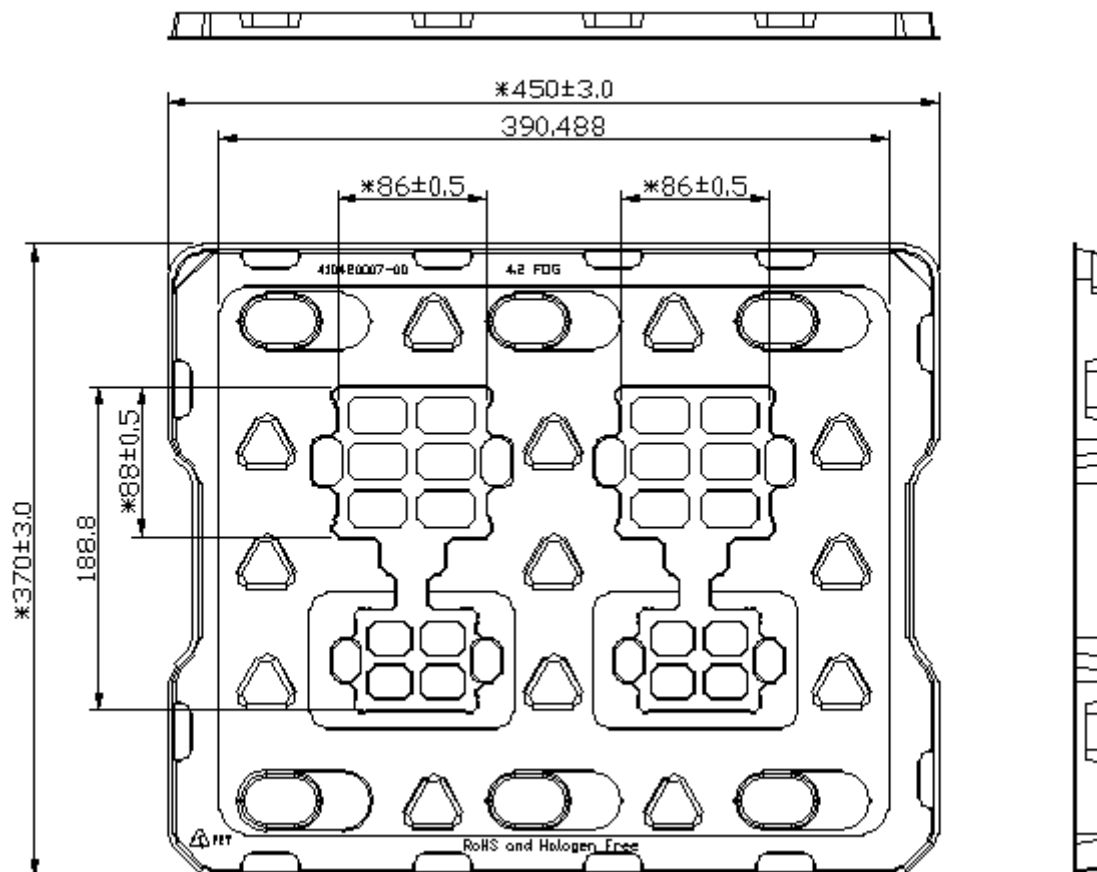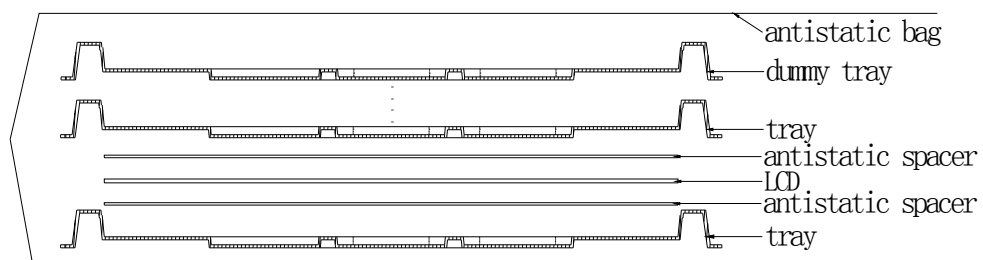

Fig 6

Fig 7

11.2 Little carton

Put four Corner EPE and two Up-down EPE around the products. Then put all of them in one little carton. The dimension of little carton is about 520(L)*440(W)*115(H)mm.
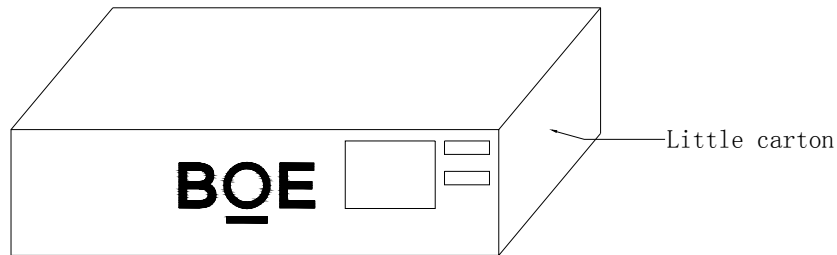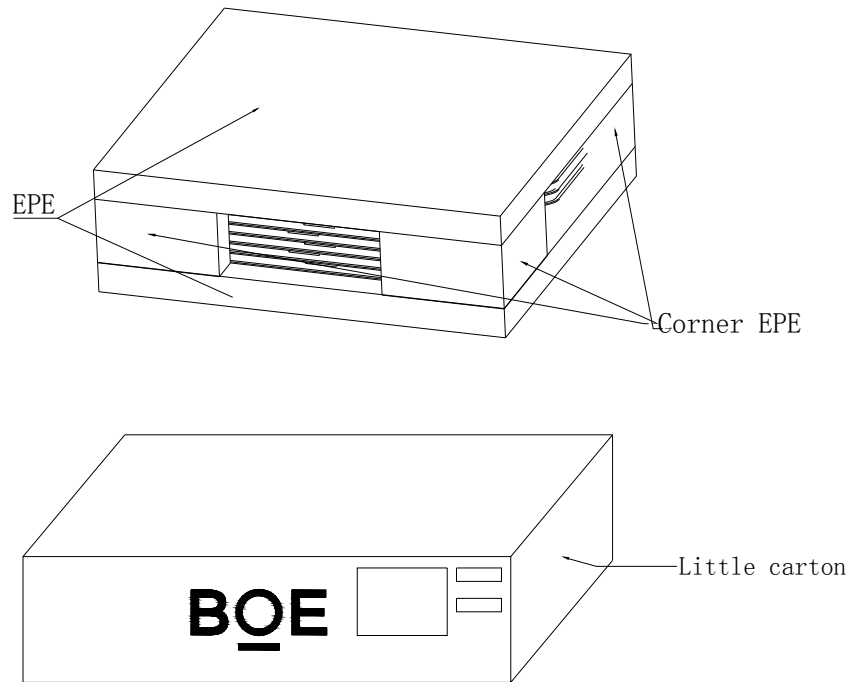
EPE

Corner EPE

Little carton

Fig 8

11.3 Big carton

Put four little cartons in one big carton. So there are eight LCD in one big carton totally. The dimension of big carton is about 545(L)*465(W)*500(H)mm.
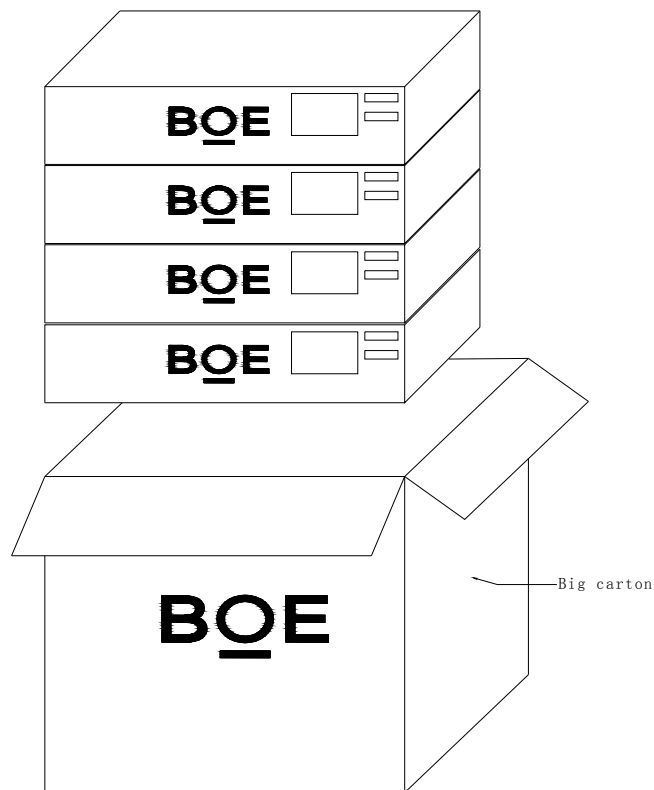
Big carton

Fig 9

11.4 Packing Notice

- Panel should be placed upwardly while in the box.
- Every spacer should be put under every panel.
- Panels should be packed in a vacuum with PE (anti-ESD) bag.

12.0 Handling & Cautions

12.1 Mounting Method

● The panel of the LCD consists of two thin glasses with polarizers which easily get damaged.
So extreme care should be taken when handling the LCD.

● Excessive stress or pressure on the glass of the LCD should be avoided. Care must be taken
to insure that no torsional or compressive forces are applied to the LCD unit when it is mounted.

● If the customer's set presses the main parts of the LCD, the LCD may show the abnormal
display. But this phenomenon does not mean the malfunction of the LCD and should be pressed by the
way of mutual agreement.

● To determine the optimum mounting angle, refer to the viewing angle range in the specification for each
model.

● Mount a LCD module with the specified mounting parts.

12.2 Caution of LCD Handling and Cleaning

● Since the LCD is made of glass, do not apply strong mechanical impact or static load onto it.
Handling with care since shock, vibration, and careless handling may seriously affect the product. If it falls
from a high place or receives a strong shock, the glass maybe broken.

● The polarizer on the surface of panel are made from organic substances. Be very careful
for chemicals not to touch the polarizer or it leads the polarizer to be deteriorated.

● If the use of a chemical is unavoidable, use soft cloth with solvent（recommended below）to clean the
LCD's surface with wipe lightly.

-IPA (Isopropyl Alcohol),Ethyl Alcohol, Tri-chloro, tri-florothane..

● Do not wipe the LCD's surface with dry or hard materials that will damage the polarizer, And others,
Do not use the following solvent.

-Water, acetone, Aromatics.

● It is recommended that the LCD be handled with soft gloves during assembly, etc.
The polarizer on the LCD's surface are vulnerable to scratch and thus to be damaged by shape particles.

● Do not drop water or any chemicals onto the LCD's surface.

● A protective film is supplied on the LCD and should be left in place until the LCD is required
for operation.

● The ITO pad area needs special careful caution because it could be easily corroded. Do not
contact the ITO pad area with HCFC, Soldering flux, Chlorine, Sulfur, saliva or fingerprint. To prevent
from the ITO corrosion, customers are recommended that the ITO area would be covered by UV or
silicon.

● Please clean the LCD without ultrasonic to avoid line open

12.3 Caution Against Static Charge

● The LCD modules use C-MOS LSI drivers, so customers are recommended that any unused
input terminal would be connected to Vdd or Vss, do not input any signals before power is

turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.

● Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, if possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.

● Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.

● In handling the LCD, wear non-charged material gloves. And the conducting wrist to the   earth and the conducting shoes to the earth are necessary.

12.4 Caution For operation

● It is indispensable to drive the LCD within the specified voltage limit since the higher voltage than the limit causes the shorter LCD's life. An electro-chemical reaction due to DC causes undesirable deterioration of the LCD so that the use of DC drive should avoid.

● Do not connect or disconnect the LCD to or from the system when power is on.

● Never use the LCD under abnormal conditions of high temperature and high humidity.

● When expose to drastic fluctuation of temperature(hot to cold or cold to hot）,the LCD may be affected; specifically, drastic temperature fluctuation from cold to hot, produces dew on the LCD's surface which may affect the operation of   the polarizer and the LCD.

● Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD may turn black at temperature above its operational range. However those phenomena do not mean malfunction or out of order with the LCD. The LCD will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.

● Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.

12.5 Packaging

● Modules use LCD element, and must be treated as such.

-Avoid intense shock and falls from a height.

-To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

12.6 Storage

● A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in   terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH.

● Original protective film should be used on LCD's surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizer.

●   Do not store the LCD near organic solvents or corrosive gasses.

● Keep the LCD safe from vibration, shock and pressure.

● Black or white air-bubbles may be produced if the LCD is stored for long time in the lower

temperature or mechanical shocks are applied onto the LCD.

● In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.

-Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.

-Store in a dark place where neither exposure to direct sunlight nor light is.

-Keep temperature in the specified storage temperature range.

-Store with no touch on polarizer surface by the anything else. If possible, store the LCD in the packaging situation LCD when it was delivered.

12.7 Safety

● For the crash damaged or unnecessary LCD, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol an should be burned up later.

● In the case the LCD is broken, watch out whether liquid crystal leaks out or not. If your hands Touch the liquid crystal, wash your hands cleanly with water an soap as soon as possible.

● If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then Drink a lot of water and induce vomiting, and then, consult a physician.

● If the liquid crystal get in your eyes, flush your eyes with running water for at least fifteen minutes.

● If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.