Specification
For
Approval

■ Preliminary specification
□ Final specification

Title	**1.54 240*240 ADS TFT-LCD (Module)**

Buyer	
Model	

Supplier	Cheng Du BOE Optoelectronics Technology CO., LTD
Model	**1.54 240*240**

TITLE/SIGNATURE　　DATE	ITEM　　SIGNATURE/DATE
_____　　_____	Approved　　_____
_____　　_____	Reviewed　　_____
_____　　_____	Reviewed　　_____
_____　　_____	Prepared　　_____
Please return one copy confirmation with signature and your comments	BOE CHENG DU Optoelectronics Technology CO., LTD

CONTENT LIST

Record of Revisions				
Revision	Date	Page	Description	Released by
Pre.0	2014.03.17		Initial Released	Huangli

1.0 GENERAL DESCRIPTION

1.1 Introduction

1.54 240*240 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, a driving circuit and a back light system. It is a transmissive type display operating in the normal black. This TFT-LCD has a 1.54 inch diagonally measured active area with 240 horizontal by 240 vertical pixel array. Each pixel is divided into Red, Green, Blue dots which are arranged in vertical stripe and this panel can display 262K colors.
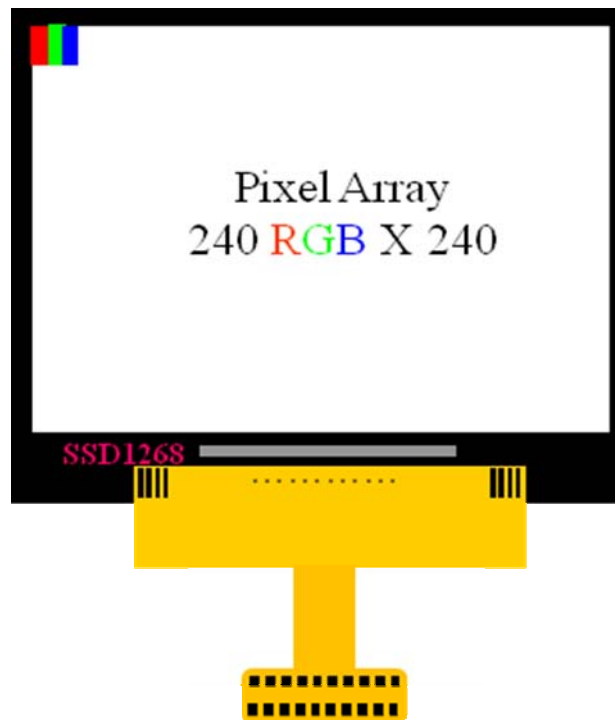
1.2 Features

- 0.36 t Glass

- Thin and light weight

- Low Power consumption, High trans, High CR, Wide view angle

- Module Design

- RoHS Compliant

1.3 Application

- Smart watch

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

Parameter	Specification	Unit	Remark
Active Area	27.72(H) × 27.72(V)	mm	
Number of Pixels	240(H) RGB × 240(V)	pixels	
Pixel Pitch	0.1155 (H) × 0.1155 (V)	mm	
Pixel Arrangement	RGB Vertical Stripe		
Display Colors	262K	colors	
Color Gamut	50% (typ.)		
Display Mode	Normally Black, Transmissive mode		
Dimensional Outline	31.82(H) × 33.72(V) × 1.147(D)	mm	Module
Polarizer Surface treatment	AR		
Viewing Direction (Human Eye)	80/80/80/80		Note 1,2
D-IC	SSD1268		
Weight	TBD	gram	

Note:

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

2. The TFT and CF Rubbing Direction;
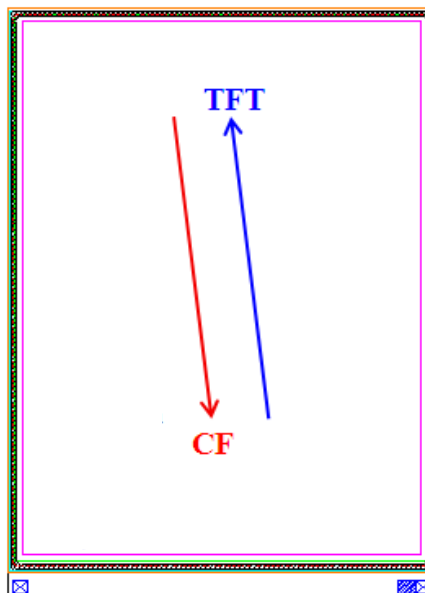
2.0 ELECTRICAL SPECIFICATION

2.1 Absolute Maximum Ratings

The absolute maximum ratings are list on table as follows. When used out of the absolute maximum ratings, the LSI may be permanently damaged. Using the LSI within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the LSI will malfunction and cause poor reliability.

Symbol	Parameter	Value	Unit
VDDIO	Supply Voltage	-0.3 to +4.0	V
VCI	Input Voltage	VSS - 0.3 to 4.0	V
I	Current Drain Per Pin Excluding V_{DDIO} and V_{SS}	25	mA
T_A	Operating Temperature	-40 to +85	°C
T_{stg}	Storage Temperature	-65 to +150	°C

Note:

If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings

2.2 DC characteristics

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
VDDIO	Power supply pin of IO pins	Recommend Operating Voltage Possible Operating Voltage	1.4	-	3.3	V
VCI	Booster Reference Supply Voltage Range	Recommend Operating Voltage Possible Operating Voltage	2.4 or VDDIO whichever is higher	-	3.3	V
VGH	Gate driver High Output Voltage Booster efficiency	No panel loading; 4x or 5x booster; ITO for CYP, CYN, VCIX2, VCI and VCHS = 10 Ohm	85	90	-	%
		No panel loading; 6x booster; ITO for CYP, CYN, VCIX2, VCI and VCHS = 10 Ohm	85	90	-	%
VCIX2	VCIX2 primary booster efficiency	No panel loading, ITO for CYP, CYN, VCIX2, VCI and VCHS = 10 Ohm	85	90	-	%
VGH	Gate driver High Output Voltage		8	-	17	V
VGL	Gate driver Low Output Voltage		-14	-	-5	V
VLCD63	Max. Source Voltage		3.5	-	5.5	V
ΔVLCD63	Source voltage variation		-3	-	3	%
V_{OH1}	Logic High Output Voltage	Iout=-100µA	0.8*VDDIO	-	VDDIO	V
V_{OL1}	Logic Low Output Voltage	Iout=100µA	0	-	0.2*VDDIO	V
V_{IH1}	Logic High Input voltage		0.8*VDDIO	-	VDDIO	V
V_{IL1}	Logic Low Input voltage		0	-	0.2*VDDIO	V
I_{OH}	Logic High Output Current Source	Vout = V_{DDIO}-0.4V	50	-	-	µA
I_{OL}	Logic Low Output Current Drain	Vout = 0.4V	-	-	-50	µA

2.3 Backlight Driving Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Remark
LED Forward Voltage	V_F		3.2		V	-
LED Forward Current	I_F		40		mA	-
LED Power Consumption	P_{LED}		TBD		W	Note 1

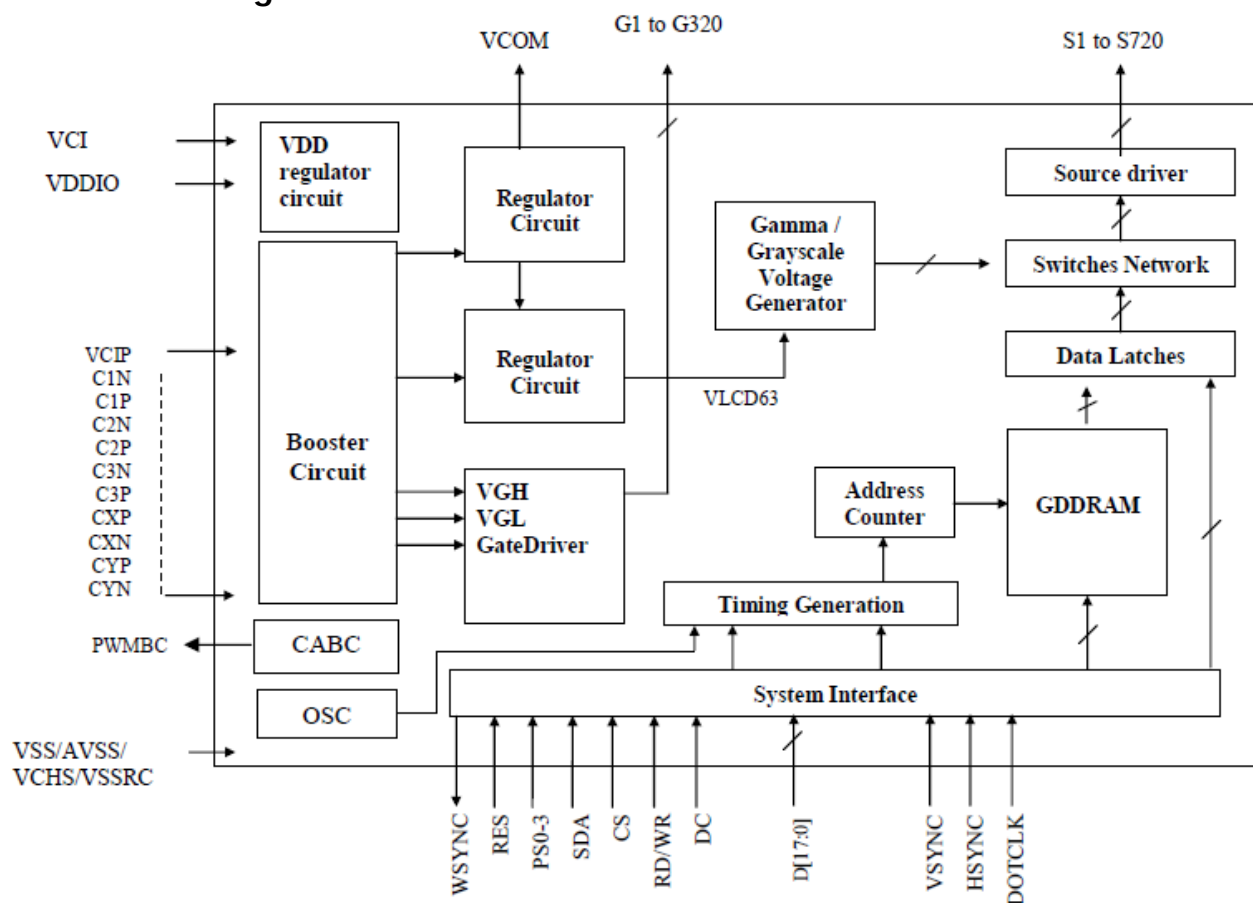**Notes:**

1. Calculator Value for reference $ILED \times VLED \times LED$ Quantity $= PLED$
2. The LED Life-time define as the estimated time to 50% degradation of initial luminous.

2.4 Power Consumption

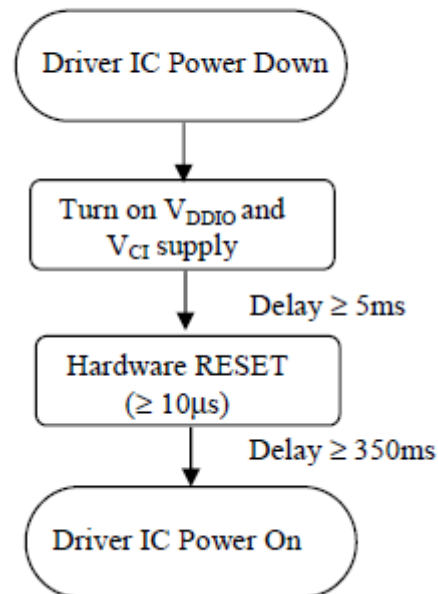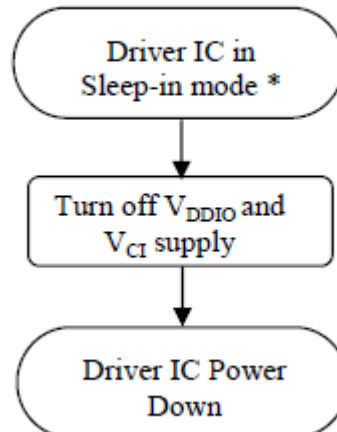| Parameter	Symbol	Typ	Max	Unit	Remark
Normal mode	$I_{VDDI} + I_{VCI}$	TBD	TBD	mA	
Sleep mode	$I_{VDDI} + I_{VCI}$	TBD	TBD	uA	

2.5 Block Diagram

2.6 Power ON/OFF Sequence

The power supply ON/OFF setting sequences is illustrated in figure below.

Power On Sequence

Driver IC Power Down

↓

Turn on V_{DDIO} and V_{CI} supply

Delay ≥ 5ms

↓

Hardware RESET
(≥ 10μs)

Delay ≥ 350ms

↓

Driver IC Power On

Power Off sequence

Driver IC in
Sleep-in mode *

↓

Turn off V_{DDIO} and V_{CI} supply

↓

Driver IC Power Down

3.0 SIGNAL TIMING SPECIFICATION

Write Cycle
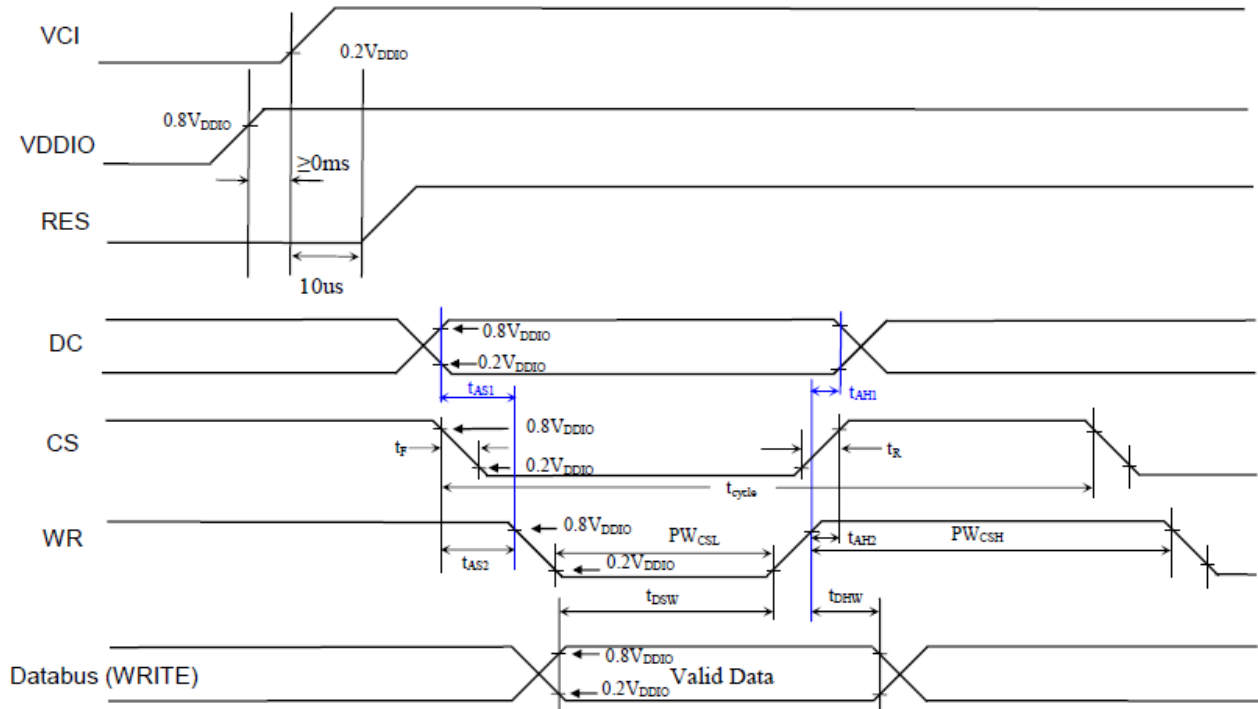
Read Cycle
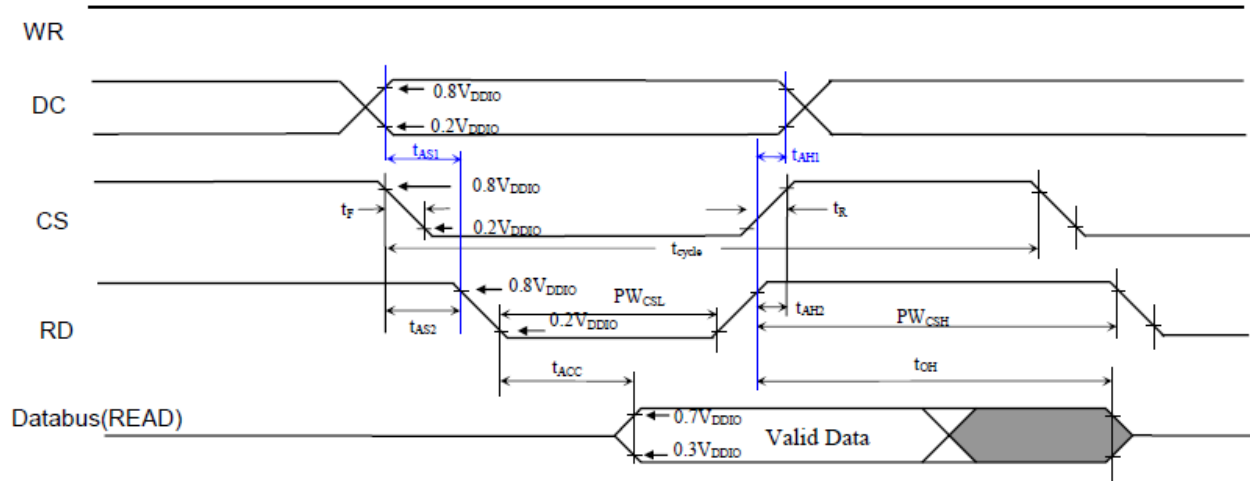
Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	100		-	ns
t_{cycle}	Clock Cycle Time (read cycle) (Based on VOL/VOH = 0.3*VDDIO/0.7*VDDIO)	1000		-	ns
t_{AS1}	Address Setup Time between ($R/\overline{W}$) and $D/\overline{C}$	0		-	ns
t_{AH1}	Address Hold Time between ($R/\overline{W}$) and $D/\overline{C}$	0		-	ns
t_{AS2}	Address Setup Time between ($R/\overline{W}$) and $\overline{CS}$	0		-	ns
t_{AH2}	Address Hold Time between ($R/\overline{W}$) and $\overline{CS}$	0		-	ns
t_{DSW}	Data Setup Time (D0~D7, WRITE)	10		-	ns
t_{DHW}	Data Hold Time (D0~D7, WRITE))	10		-	ns
t_{ACC}	Data Access Time (D0~D7, READ)	150		-	ns
t_{OH}	Output Hold time (D0~D7, READ)	10		50	ns
PW_{CSL}	Pulse width /CS low (write cycle)	50		-	ns
PW_{CSH}	Pulse width /CS high (write cycle)	50		-	ns
PW_{CSL}	Pulse width /CS low (read cycle)	500		-	ns
PW_{CSH}	Pulse width /CS high (read cycle)	500		-	ns
t_R	Rise time	-		15	ns
t_F	Fall time	-		15	ns

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
Threshold Voltage		Vsat		4.1	4.3	4.5	V	Fig.1
		Vth		1.6	1.8	2.0	V	
Viewing Angle	Horizontal	Θ3	CR>10		80		°	Note 1
		Θ9			80		°	
	Vertical	Θ12			80		°	
		Θ6			80		°	
Contrast Ratio		CR	Θ= 0°		900			Note 2
Luminance		cd/m2	Θ= 0°		450		lm	Note 3
Uniformity		%	Θ= 0°					Note 4
NTSC		%	Θ= 0°		50			
Reproduction Of color	Red	Rx	Θ= 0°		TBD			Note 4 *Module
		Ry			TBD			
	Green	Gx			TBD			
		Gy			TBD			
	Blue	Bx			TBD			
		By			TBD			
White		Wx	Θ= 0°		TBD			
		Wy			TBD			
Response Time		Tr+Tf	Θ= 0°		35	50	ms	Note 5

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).

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. Surface luminance is the center point across the LCD surface 50cm from the surface with all pixels displaying white. This measurement shall be taken at the locations shown in FIG. 2.

4. Uniformity measurement shall be taken at the locations shown in FIG. 2&3, for a total of the measurements per display, measure surface luminance of these nine points across the LCD surface 50cm from the surface with all pixels displaying white.

$$\text{Uniformity} \quad = \quad \frac{\text{Min Luminance of 9 points}}{\text{Max Luminance of 9 points}} \times 100\%$$

5. 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 Module.

6. The electro-optical response time measurements shall be made as FIG.4 by switching the "data" input signal ON and OFF.

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

Figure 1. The definition of Vth & Vsat
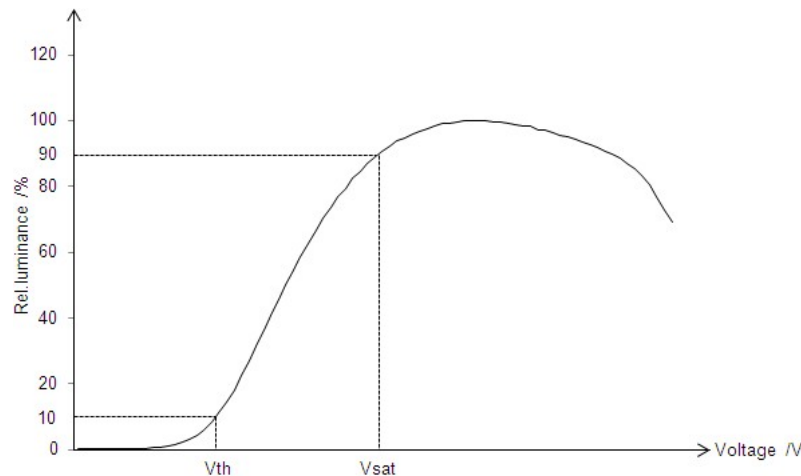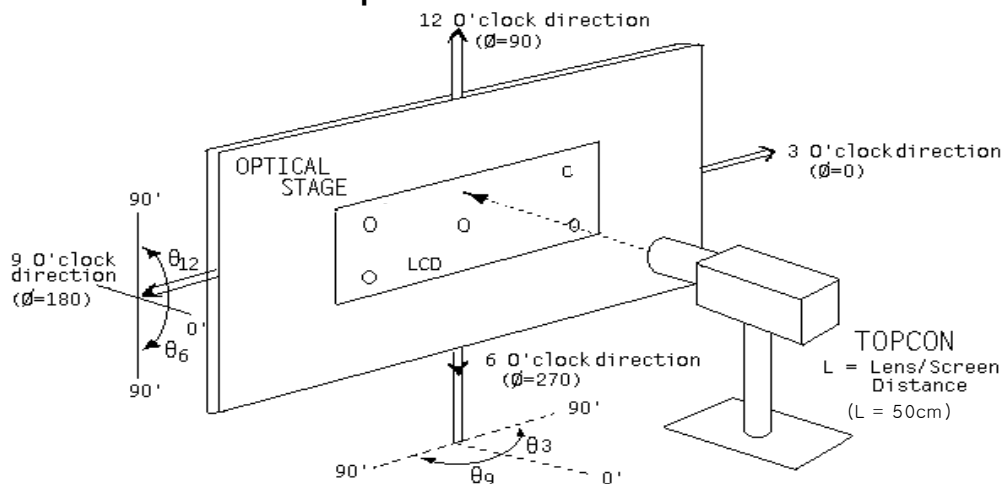

Figure 2. Measurement Set Up

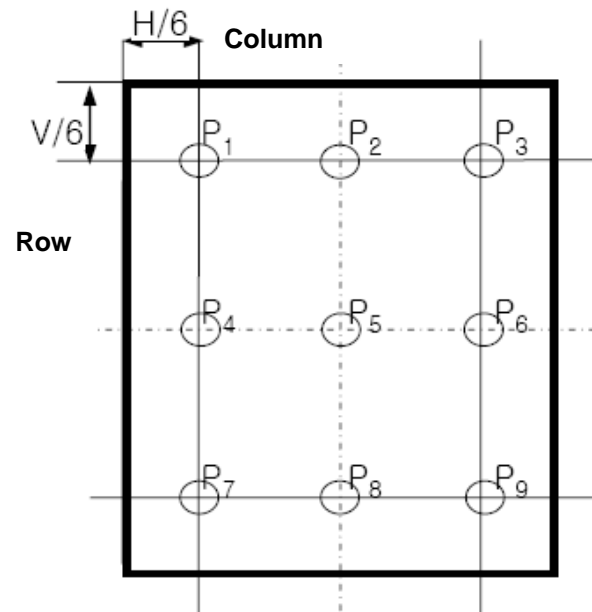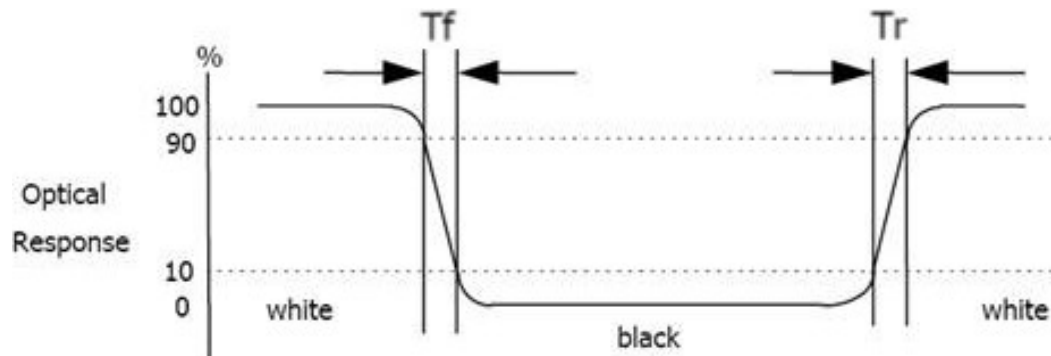**Figure 3. Uniformity Measurement Locations**

Figure 4. Response Time Testing

5.0 MECHANICAL CHARACTERISTICS

5.1 Dimension Requirements

Mechanical outlines for the panel (H: horizontal length, V: Vertical length)

Parameter	Specification	Unit	Remark
Panel size	30.12(H) × 33.12(V)	mm	
CF size	30.12(H) × 30.62(V)	mm	
Active area	27.72(H) × 27.72(V)	mm	
Number of pixels	240(H)RGB × 240(V)	pixels	
	(1 pixel = R + G + B dots)		
Pixel pitch	0.1155 (H) × 0.1155 (V)	mm	
Pixel arrangement	RGB Vertical Stripe		
Panel ID	1.6 × 2	mm	
COG pad area	2.5	mm	
D-IC to FPC distance	0.48	mm	
D-IC width	0.65	mm	Note
D-IC to CF edge	0.52	mm	
FPC to Glass edge	0.15	mm	
FPC width	0.7	mm	
Seal Area (U/D/L/R)	1.2/1.2/1.0/1.9	mm	
Dimensional outline	31.82(H) × 33.72(V) × 1.147(D)	mm	Module
Display mode	Normally Black		

Note:

The size specified is calculated by IC–driver SSD1268, the size maybe changed if customer use other IC.
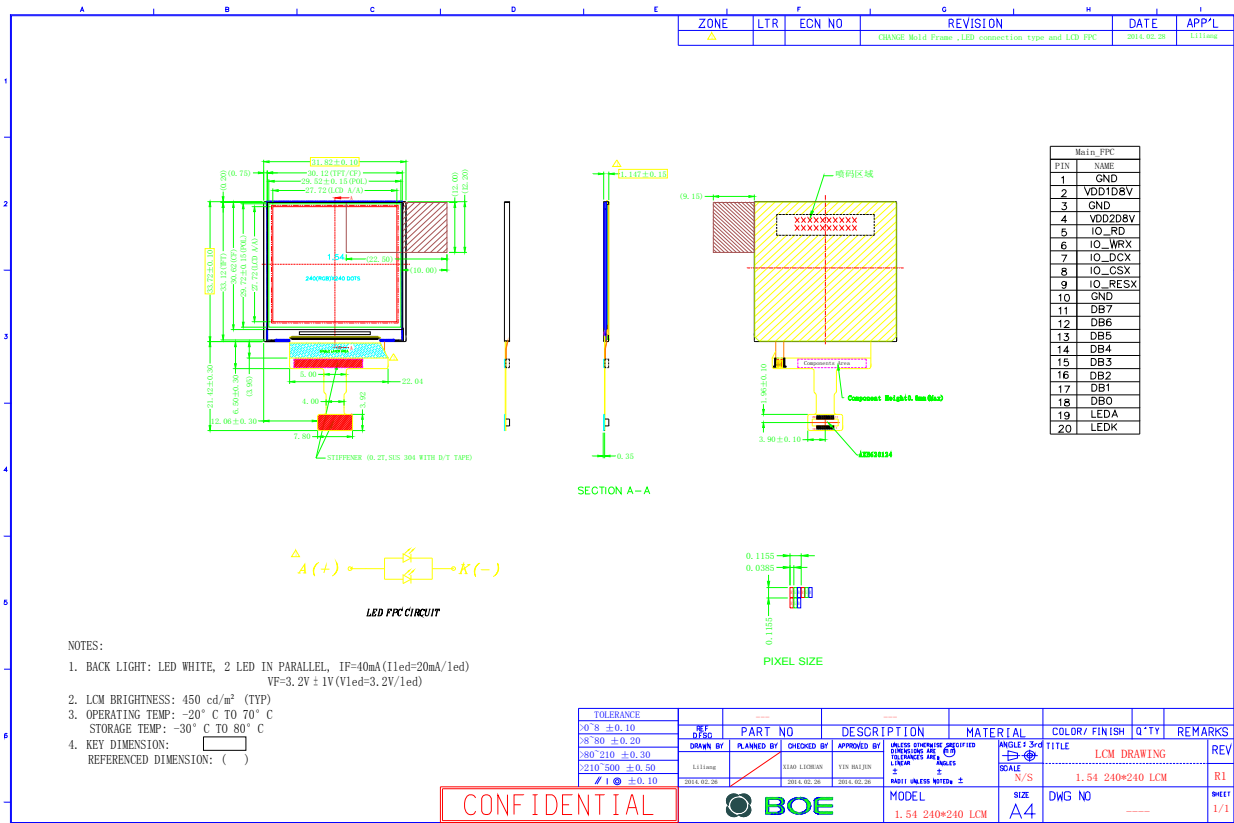
Figure 5. LCM Outline Dimension (unit:mm)

Main_FPC	
PIN	NAME
1	GND
2	VDD1D8V
3	GND
4	VDD2D8V
5	IO_RD
6	IO_WRX
7	IO_DCX
8	IO_CSX
9	IO_RESX
10	GND
11	DB7
12	DB6
13	DB5
14	DB4
15	DB3
16	DB2
17	DB1
18	DB0
19	LEDA
20	LEDK

NOTES:

1. BACK LIGHT: LED WHITE, 2 LED IN PARALLEL, IF=40mA(I1ed=20mA/1ed)
   VF=3.2V±1V(V1ed=3.2V/1ed)
2. LCM BRIGHTNESS: 450 cd/m² (TYP)
3. OPERATING TEMP: -20°C TO 70°C
   STORAGE TEMP: -30°C TO 80°C
4. KEY DIMENSION:
   REFERENCED DIMENSION: ( )

Figure 6. BLU Outline Dimension (unit:mm)

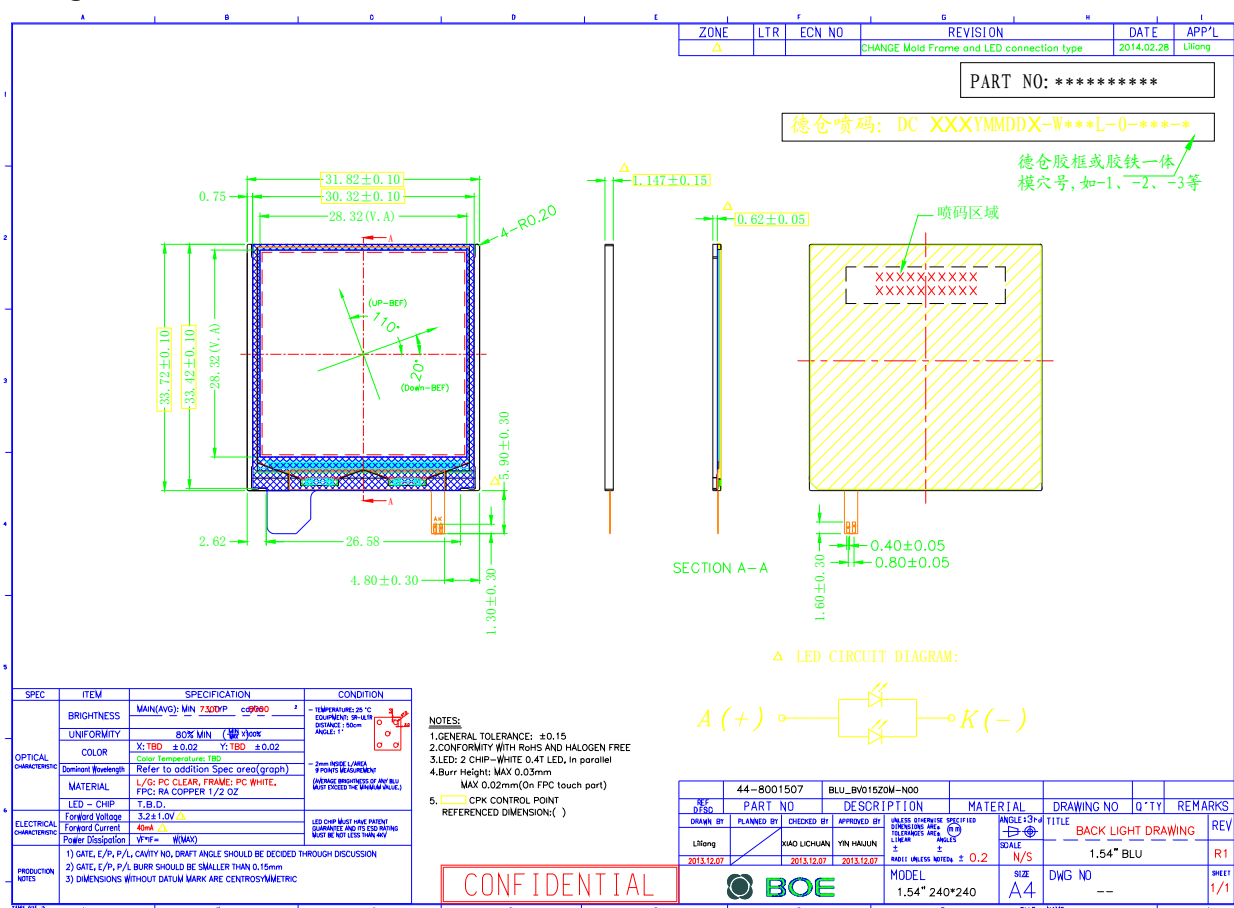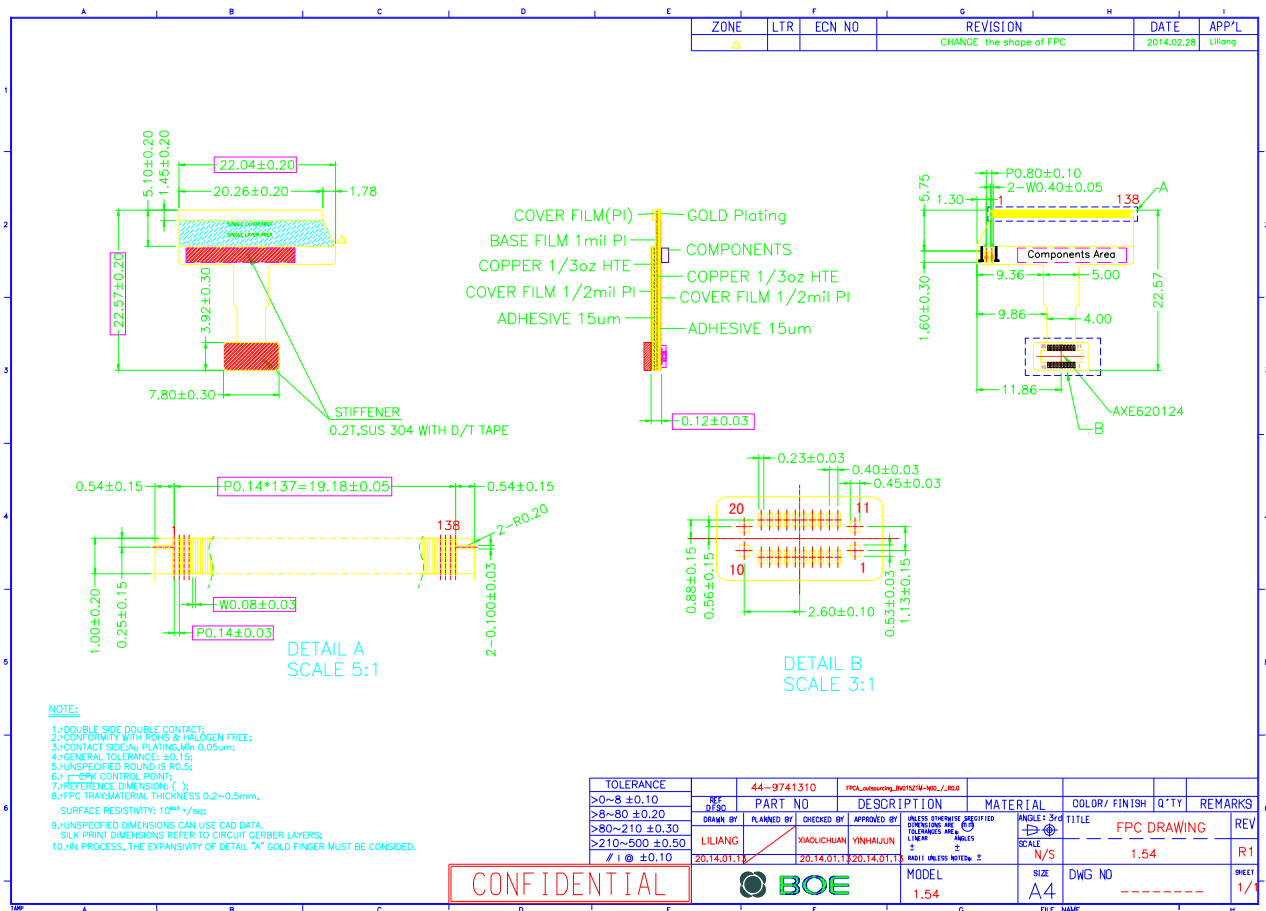## Figure 7. FPC main structure (unit:mm)

6.0 RELIABILITY TEST

TBD

7.0 PACKING METHOD

TBD

8.0 PRODUCT ID RULE

B V 015 Z1 M – N 0 0
①② ③ ④ ⑤ ⑥⑦⑧

① \<Company>

Code	Description
B	Mobile
N	Notebook
S	Special display

② \<Mode>

Code	Description
V	ADS-a Si
T	TN-a Si
S	ADS-LTPS

③ \<Size>

Code	Description
015	1.54"
055	5.5"
060	6.0"

④ \<Resolution>

Code	Description
Z1	Special resolution
FH	FHD
WH	WQHD

⑤ \<Production type>

Code	Description
M	Module
Q	Q-Panel
E	Cell

⑥ \<Product state>

Code	Description
N	Normal
E	In Cell Touch
A	Add On Touch

⑦ \<Product Rev>

Code	Description
0	First Mode
1	Second Mode
2	Third Mode

⑧ \<Product Rev>

Code	Description
0	First Mode
1	Second Mode
2	Third Mode

9.0 HANDDLING & CAUTIONS

9.1 Mounting Method

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

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

● If the customer's set presses the main parts of the LCM, the LCM may show the abnormal display. But this phenomenon does not mean the malfunction of the LCM 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 LCM with the specified mounting parts.

9.2 Caution of LCM Handling and Cleaning

● Since the LCM 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 LCM's surface with wipe lightly.
-IPA (Isopropyl Alcohol), Ethyl Alcohol, Tri-chloro, tri-florothane.

● Do not wipe the LCM'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 LCM be handled with soft gloves during assembly, etc.
The polarizer on the LCM's surface are vulnerable to scratch and thus to be damaged by shape particles.

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

● A protective film is supplied on the LCM and should be left in place until the LCM 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.

9.3 Caution Against Static Charge

● The LCM 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 LCM, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

9.4 Caution For Operation

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

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

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

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

● Response time will be extremely delay at lower temperature than the operating temperature range and on the other hand LCM may turn black at temperature above its operational range. However those phenomenon do not mean malfunction or out of order with the LCM. The LCM 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 LCM structure. If the screen is displayed with fixed pattern, use a screen saver.

● Do not disassemble and/or re-assemble LCM module

9.5 Packaging

● Modules use LCM 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.

9.6 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 LCM'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 LCM near organic solvents or corrosive gasses.

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

● Black or white air-bubbles may be produced if the LCM is stored for long time in the lower temperature or mechanical shocks are applied onto the LCM.

● 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 LCM in the packaging situation when it was delivered.

9.7 Safety

● For the crash damaged or unnecessary LCM, 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 of LCM is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water and 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.

10.0 Applicable Scope

●This product specification only applies to the products manufactured and sold by our company.

● Any specification, quality etc. about other parts mentioned in this product spec are no concern of our company.