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PRODUCTION SPECIFICATION OF LCD MODULE MODULE NO.：ET025WF01-G

Customer Name:			
Customer Part Number:			
Approved By:		**Date:**	

Prepared By	Checked By	Approved By

CONTENT LIST

Record of Revisions				
Revision	Date	Page	Description	Released by
Rev.0	2019.04.18		Initial Released	

1.0 GENERAL DESCRIPTION

1.1 Introduction

ET025WF01-G is a color active matrix TFT-LCD Panel 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 2.47 inch diagonally measured active area with resolutions of 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

- 0.4t Glass (Single)
- Thin and light weight
- High luminance and contrast ratio, wide viewing angle
- Module Design
- RoHS Compliant

1.3 Application

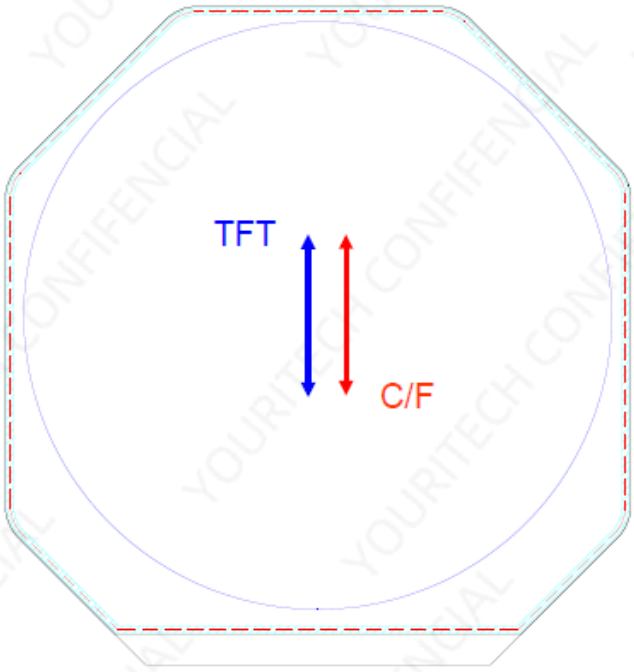
- White goods

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

Parameter	Specification	Unit	Remark
Active Area	62.64 × 62.64(circle)	mm	
Number of Pixels	480RGB × 480	pixels	
Pixel Pitch	130.5(H) × 130.5(V)	um	
Pixel Arrangement	RGB 2domain stripe		
Display Colors	16.7 M	colors	
Color Gamut	70%(typ.)		
Display Mode	Normally Black, Transmissive mode		
Dimensional Outline	69.19±0.2(H) × 71.74±0.2(V) × 2.45±0.2(D)	mm	No with Component and FPC
Viewing Direction (Human Eye)	U/D/L/R free viewing direction		Note 1,2
D-IC	ST7701S-G5-P		
Weight	25g (Max)	gram	

Note:

1. At the U/D/L/R direction, the viewing angle is same;
2. The TFT and CF LC Algin Direction;



2.0 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.

Parameter	Symbol	Value	Unit
Supply voltage for I/O and interface	IOVCC	-0.3~+3.6	V
Supply voltage for logic and analog	VCI	-0.3~+3.6	V
Operating temperature range	T_{OPR}	-20 ~ 70	℃
Storage Temperature range	T_{STG}	-30 ~ 80	℃

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.

3.0 ELECTRICAL SPECIFICATIONS

3.1 TFT LCD Module DC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Remark
System voltage	IOVCC	1.65	1.8	3.3	V	-
Interface operation voltage	VCI	2.5	2.8	3.6	V	-
Power consumption	Sleep-in mode		95	136	uW	

Note:
Frame rate=60HZ,Column Inversion, Temperature=25℃.

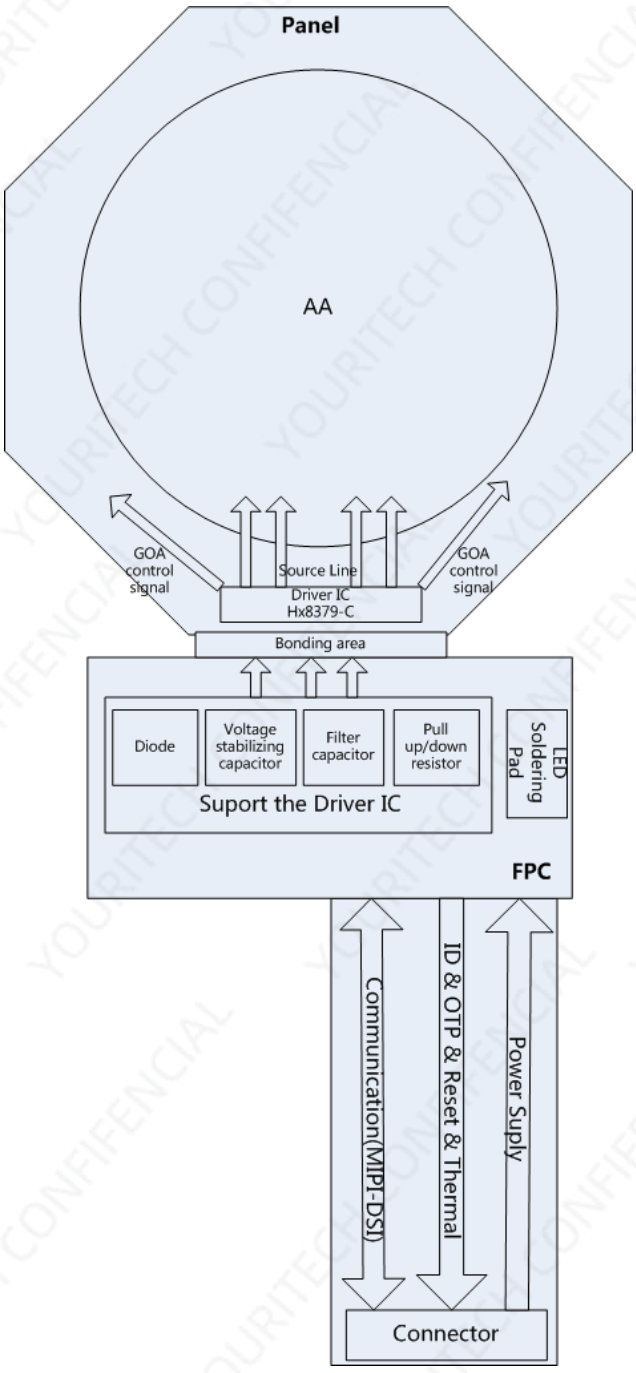
3.2 Backlight Driving Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Remark
LED Forward Voltage	V_F	16.8	18	19.2	V	V_F=6*3V
LED Forward Current	I_F	-	20	-	mA	I_F=1*20mA
LED Power Consumption	P_{LED}	-	360	-	mW	Note

Note:

1. $P_{LED}=I_F \times V_F$
2. Quantity of LED: 1line x 6LEDs per line = 6 LEDs

3.3 Block Diagram



4.0 INTERFACE CONNECTION

4.1 FPC Connector Pin map

PIN#	Pin Name	Pin Description
1	GND	Ground
2	LED_K	Power supply for LEDK
3	LED_A	Power supply for LEDA
4	NC	
5	VCI	Power supply for Analog system
6	IOVCC	Power supply for I/O system
7	NC	
8	VS	Frame sysnchronizing for RGB interface
9	HS	Line sysnchronizing for RGB interface
10	PCLK	Dot Clk signal for RGB interface operation
11	DE	Data Enable signal for RGB interface operation
12	DB0	Date Bus for RGB interface
13	DB1	Date Bus for RGB interface
14	DB2	Date Bus for RGB interface
15	DB3	Date Bus for RGB interface
16	DB4	Date Bus for RGB interface
17	DB5	Date Bus for RGB interface
18	DB6	Date Bus for RGB interface
19	DB7	Date Bus for RGB interface
20	DB8	Date Bus for RGB interface
21	DB9	Date Bus for RGB interface
22	DB10	Date Bus for RGB interface
23	DB11	Date Bus for RGB interface
24	DB12	Date Bus for RGB interface
25	DB13	Date Bus for RGB interface
26	DB14	Date Bus for RGB interface
27	DB15	Date Bus for RGB interface
28	DB16	Date Bus for RGB interface
29	DB17	Date Bus for RGB interface
30	DB18	Date Bus for RGB interface
31	DB19	Date Bus for RGB interface
32	DB20	Date Bus for RGB interface
33	DB21	Date Bus for RGB interface
34	DB22	Date Bus for RGB interface
35	DB23	Date Bus for RGB interface
36	NC	

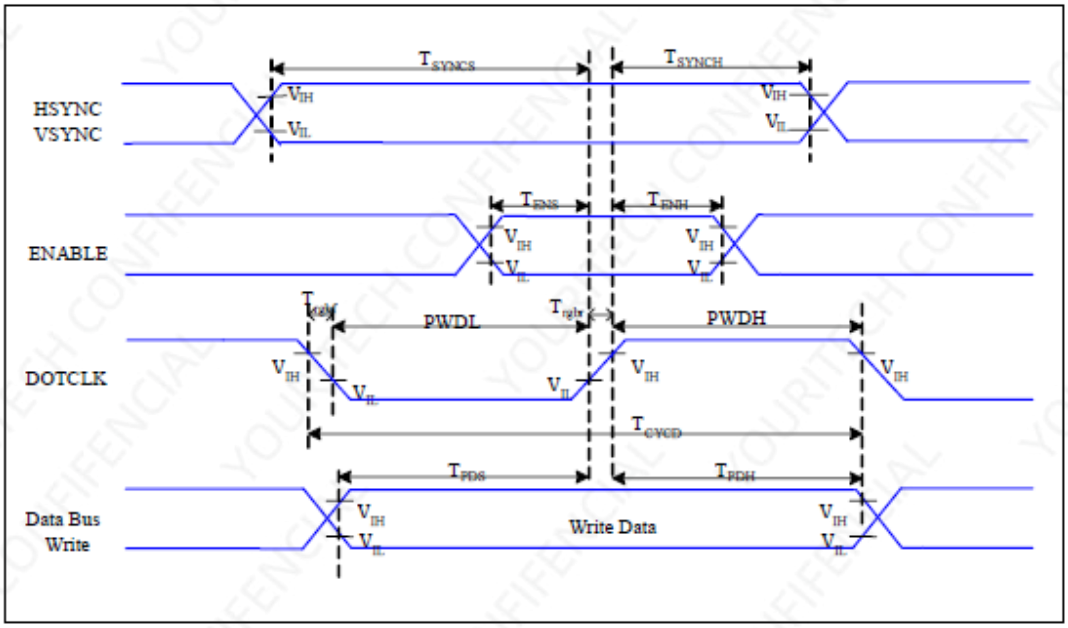
37	RESX	External reset input
38	CSX	SPI interface ,Chip select signal
39	SCL	serial clock input for SPI interface
40	DCX	signal for command or parameter select
41	SDA	SPI interface, serial data input/output bidirectional pin
42	SDO	Serial data output pin for the SPI interface
43	TE	For IC test
44	NC	
45	GND	Ground

4.2 DC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
System voltage	VCI	2.5	3.3	3.6	V
Interface operation voltage	IOVCC	1.65	1.8	3.3	V
Gate Driver High voltage	VGH	11.5	-	17	V
Gate Driver Low voltage	VGL	-7.6	-	-12	V
Logic-high input voltage	VIH	0.7VDDI		VDDI	V
Logic-high input voltage	VIL	VSS		0.3VDDI	V
Logic-high Output voltage	VOH	0.8VDDI		VDDI	V
Logic-low Output voltage	VOL	VSS		0.2VDDI	V
Logic-high input current	IIH			1	uA
Logic-low input current	IIL	−1			uA
Input Leakage currrent	IIL	−0.1		0.1	
Gamma Reference voltage(positive)	VAP	4.4		6.4	V
Gamma Reference voltage(Negative)	VAN	−2.6		−4.6	V

5.0 SIGNAL TIMING SPECIFICATION

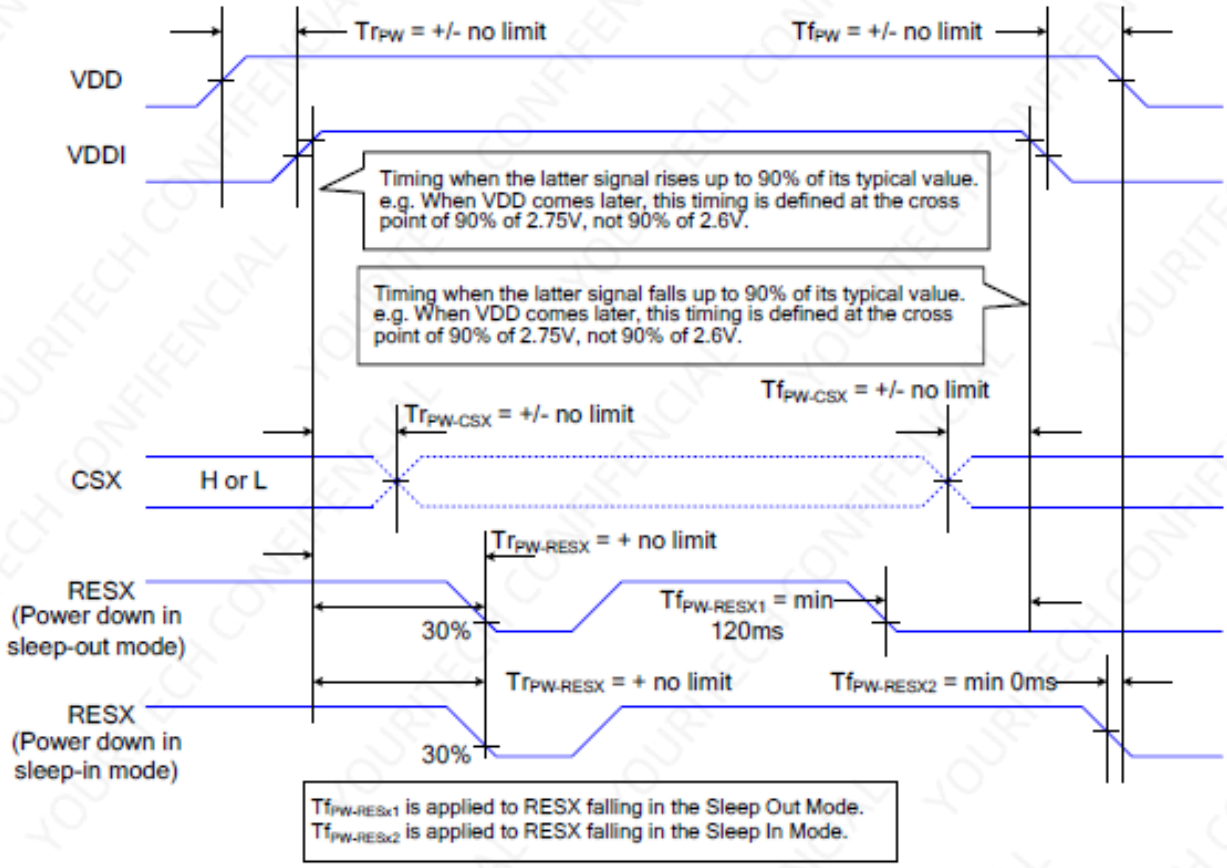
5.1 RGB interface timing



Parameter	Symbol	Parameter	Min	Max	Unit
HSYNC,VSYNC	Tsync	Vsync Hsync set up time	5		ns
ENABLE	TENs	Enable set up time	5	-	ns
	TENH	Enable set up time	5	-	ns
DTCOLK	PWDH	Dot clock High-level pulse width	15		ns
	PWDL	Dot clock Low-level pulse width	15		ns
	Tcycd	Dot clk cycle Time	33		ns
	Trghr, Trghf	Dot clk Rise/Fall Time		15	ns
DB	TPDS	PD data setup Time	5		ns
	TPDH	PD data hold Time	5		ns

6.0 POWER ON/OFF SEQUENCE

6.1 Power on/off sequency



7.0 OPTICAL SPECIFICATIONS

7.1 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.

7.2 Optical Specifications

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle	Horizontal	Θ3	CR>10	70	80		°	Note 1
		Θ9		70	80		°	
	Vertical	Θ12		70	80		°	
		Θ6		70	80		°	
Contrast Ratio		CR	Θ= 0°	800	1000			Note 2
Luminance		cd/m2	Θ= 0°	400	450		nit	Note 3
Uniformity		%	Θ= 0°	70				Note 4
NTSC		%	Θ= 0°	65	70			
Reproduction Of color	Red	Rx	Θ= 0°	0.607	0.637	0.667		Note 5 * Module
		Ry		0.298	0.328	0.358		
	Green	Gx		0.307	0.337	0.367		
		Gy		0.592	0.622	0.652		
	Blue	Bx		0.125	0.155	0.185		
		By		0.025	0.055	0.085		
White		Wx	Θ= 0°	0.283	0.313	0.343		
		Wy		0.299	0.329	0.359		
Response Time		Tr+Tf	Θ= 0°			35	ms	Note 6
Backlight FWHM		U		30			°	Note 7
		D		30			°	
		R		35			°	
		L		35			°	

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. 1.

4. Uniformity measurement shall be taken at the locations shown in FIG. 1&2, 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.

$$\text{Uniformity} = \frac{\text{Min Luminance of 13 points}}{\text{Max Luminance of 13 points}} \times 100\%$$

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.3 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.

7.Backlight luminance drop as a function of angle and report 50% from on-axis brightness.

Figure 1. Measurement Set Up

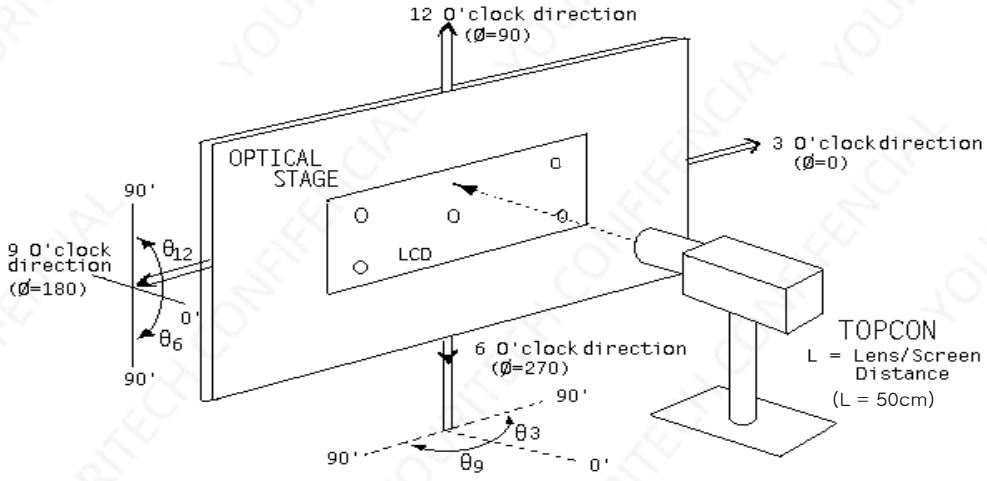


Figure 2. Uniformity Measurement Locations

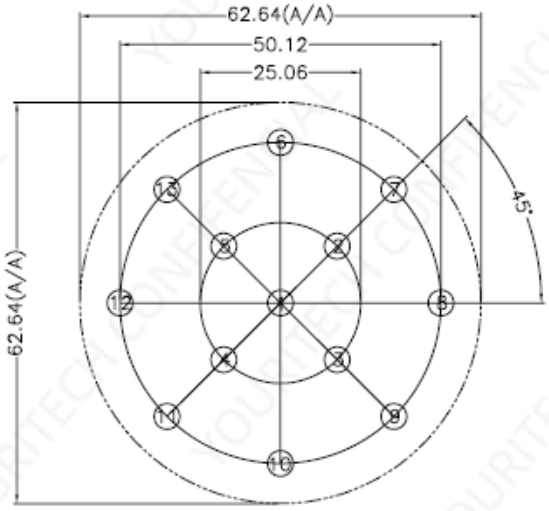
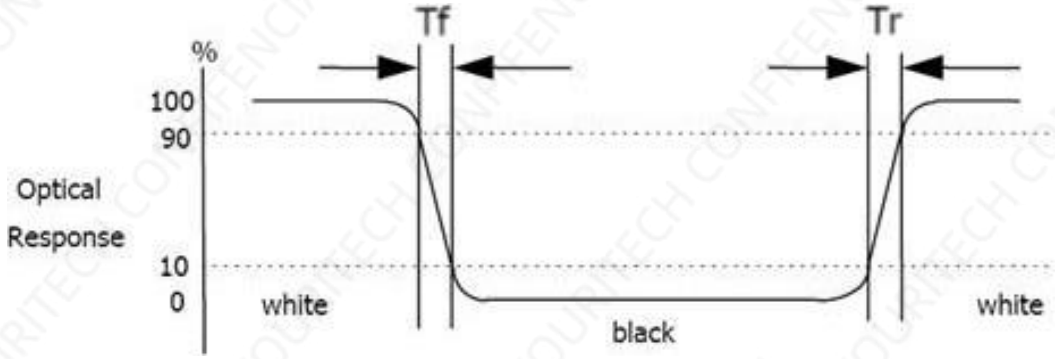


Figure 3. Response Time Testing



8.0 MECHANICAL CHARACTERISTICS

8.1 Dimension Requirements for MDL Part

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

Parameter	Specification	Unit	Remark
Panel size	70.14(V) X 66.64(H)	mm	
Active area	62.64 × 62.64(circle)	mm	
Number of pixels	480RGB × 480	pixels	
	(1 pixel = R + G + B dots)		
Dimensional outline	69.19±0.2(H) × 71.74±0.2(V) × 2.45±0.2(D)	mm	Module
Display mode	Normally Black		

Figure 5. LCM Outline Dimension (unit: mm)

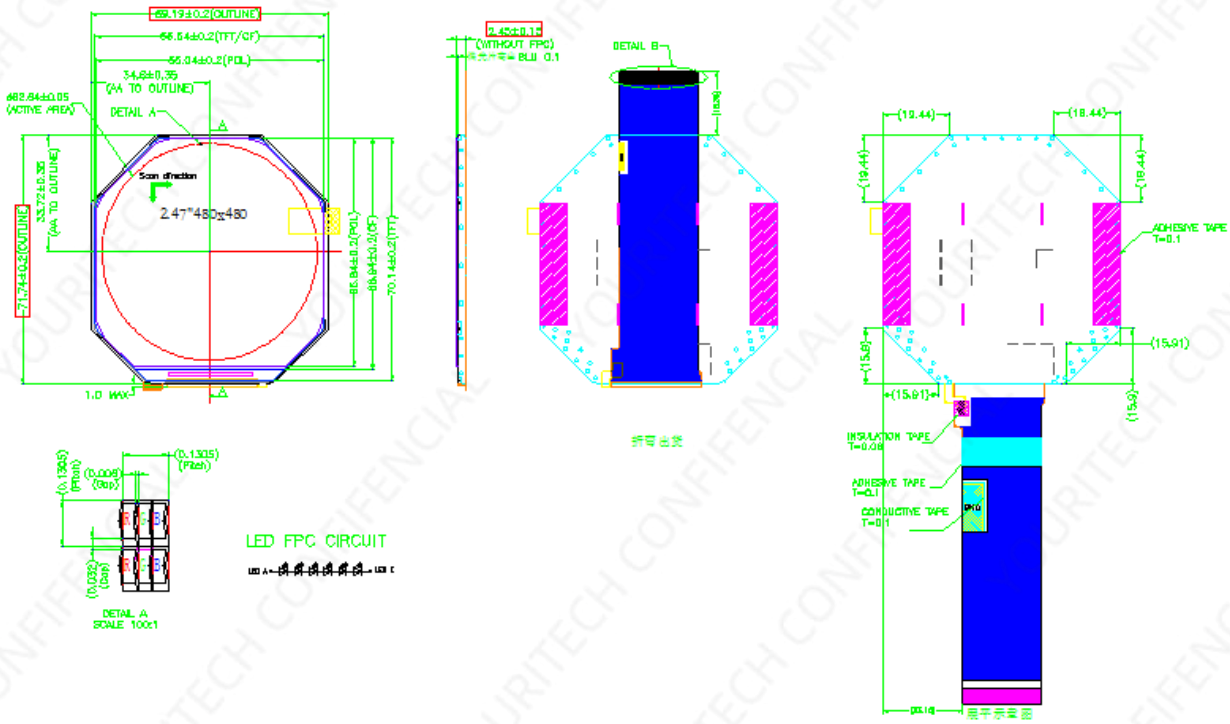
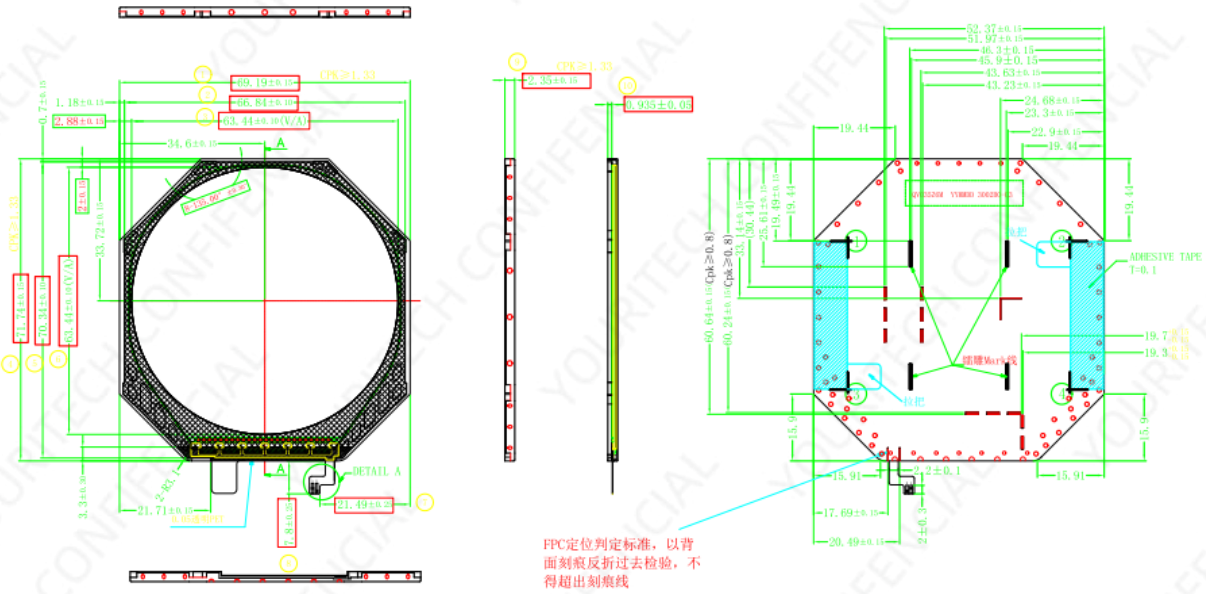
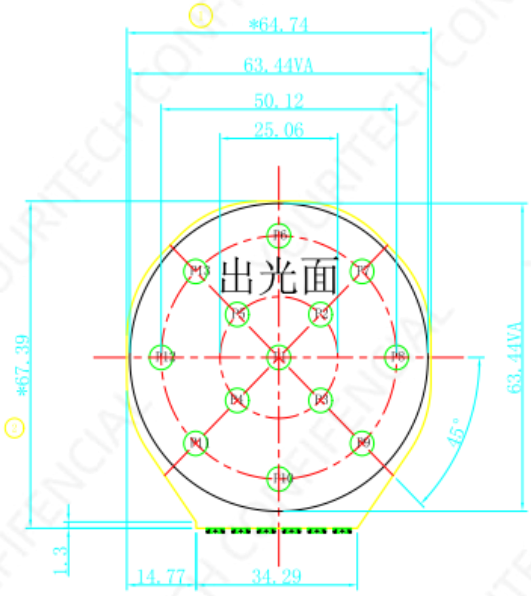
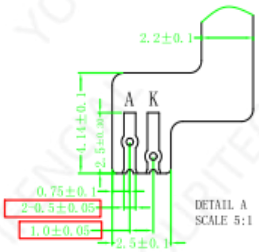


Figure 6. BLU Outline Dimension (unit: mm)







9.0 RELIABILITY TEST

NO.	Test Item	Test Condition	Duration
1	High temperature, high humidity operation test(THO)	60℃, 90%RH	240hrs
2	Low temperature operation test(LTO)	-20 ℃	240hrs
3	High temperature operation test(HTO)	70 ℃	240hrs
4	High temperature storage test(HTS)	80℃	240hrs
5	Low temperature storage test(LTS)	-30℃	240hrs
6	Thermal shock test (TST)	-30 ℃(30 min) ~ 80 ℃ (30 min)	100 Cycle

10.0 PACKING

11.0 HANDDLING & CAUTIONS

11.1 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.

11.2 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 handle FPC with care.

11.3 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.

11.4 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

11.5 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.

11.6 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.

11.7 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.

12.0 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.