



|           |                             |               |          |
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| File Name | Specification For 3.97" EPD | Module Number | T0397A01 |
| Version   | A0                          | Page Number   | 1 of 21  |

## Specification for 3.97"EPD

**Model NO.: T0397A01**

**Product VER: A0**

### Customer Approval

|                         |  |
|-------------------------|--|
| <b>Customer</b>         |  |
| <b>Approval By</b>      |  |
| <b>Date Of Approval</b> |  |

It will be agreed by the receiver, if not sign back the Specification within 15days.

|                    |                   |                    |
|--------------------|-------------------|--------------------|
| <b>Prepared By</b> | <b>Checked By</b> | <b>Approval By</b> |
| 王曉斌                | 文海                | 王浩                 |



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| Version | Content     | Date      | Producer |
|---------|-------------|-----------|----------|
| A0      | New release | 2025/7/26 | WXB      |
|         |             |           |          |
|         |             |           |          |
|         |             |           |          |



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## 1. General Description

T0397A01 is an Active Matrix Electrophoretic Display (AMEPD), with interface and a reference system design. The 4.0" active area contains 480\*800 pixels, and has B/W/R/Y full display capabilities. An integrated circuit contains gate buffer, source buffer, interface, timing control logic, oscillator, DC-DC, SRAM, LUT, VCOM and border are supplied with each panel.

## 2. Features

- 480\*800 pixels display
- High contrast
- High reflectance
- Ultra wide viewing angle
- Ultra low power consumption
- Pure reflective mode
- Bi-stable display
- Commercial temperature range
- Landscape, portrait modes
- Hard-coat antiglare display surface
- Ultra Low current deep sleep mode
- On chip display RAM
- Low voltage detect for supply voltage
- High voltage ready detect for driving voltage
- Internal temperature sensor
- Waveform stored in On-chip OTP
- Serial peripheral interface available
- On-chip oscillator
- On-chip booster and regulator control for generating VCOM, Gate and Source driving voltage
- I2C signal master interface to read external temperature sensor/ built-in temperature sensor

## 3. Typical Application

Phone back case



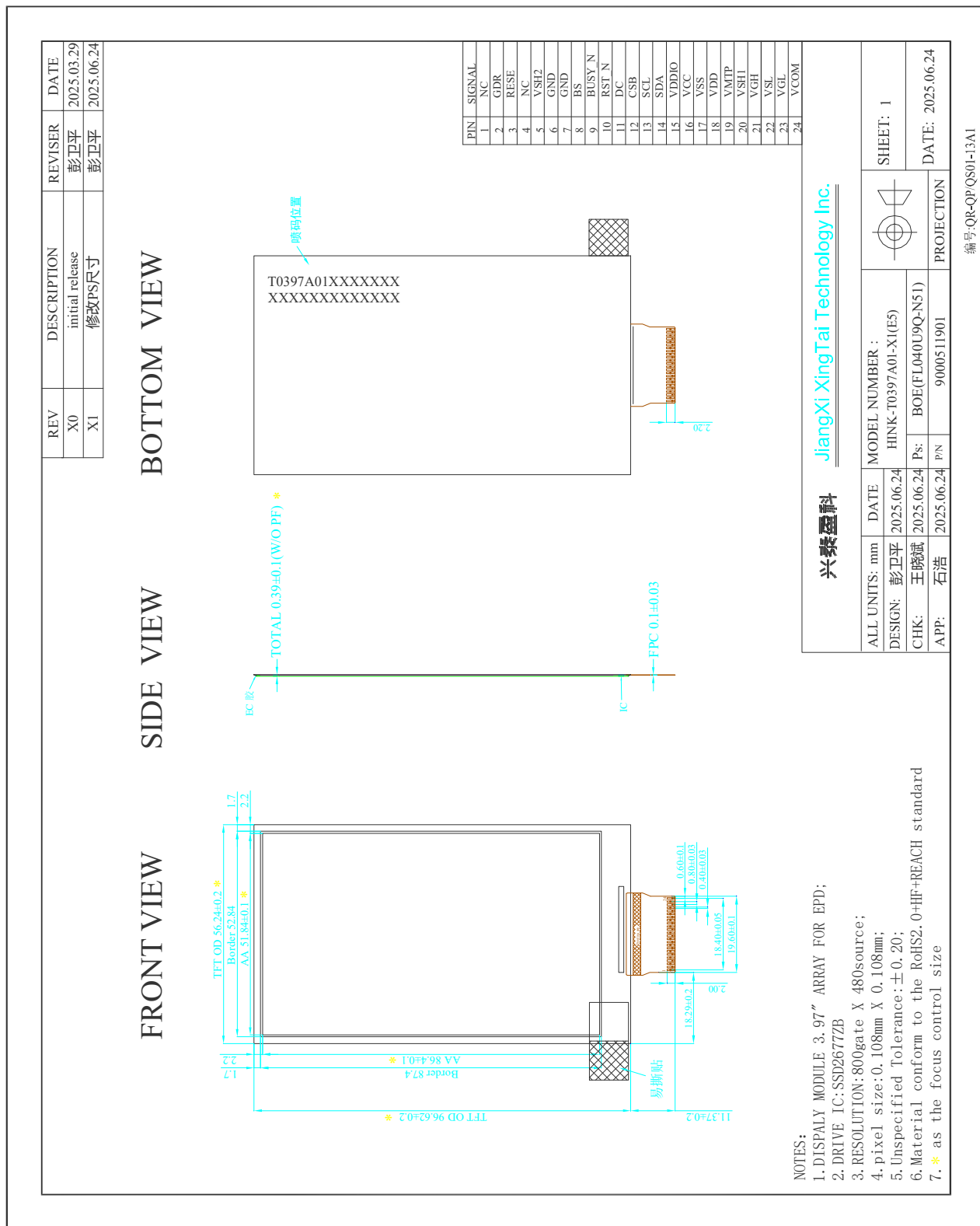
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#### 4. Mechanical Specifications

| Parameter           | Specifications           | Unit  | Remark               |
|---------------------|--------------------------|-------|----------------------|
| Screen Size         | 3.97                     | Inch  |                      |
| Display Resolution  | 480(H)*800(V)            | Pixel | Dpi:235              |
| Active Area         | 51.84(H)×86.40 (V)       | mm    |                      |
| Pixel Pitch         | 0.108mm*0.108mm          | mm    |                      |
| Pixel Configuration | Square                   |       |                      |
| Outline Dimension   | 56.24(H)*96.62(V)*0.4(D) | mm    | Without masking film |
| Weight              | /                        | g     |                      |



## 5. Mechanical Drawing of EPD module





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## 6. Input/output Terminals

| Pin # | Single | Description                                    | Remark    |
|-------|--------|------------------------------------------------|-----------|
| 1     | NC     | No connection and do not connect with other NC | Keep Open |
| 2     | GDR    | This pin is N-MOS gate control.                |           |
| 3     | RESE   | Current sense input for control loop.          |           |
| 4     | NC     | No connection and do not connect with other NC | Keep Open |
| 5     | VSH2   | Positive source voltage for Red                |           |
| 6     | GND    |                                                |           |
| 7     | GND    |                                                |           |
| 8     | BS     | Input interface setting.                       | Note 6-5  |
| 9     | BUSY_N | This pin indicates the driver status.          | Note 6-4  |
| 10    | RST_N  | Global reset pin                               | Note 6-3  |
| 11    | DC     | Serial communication Command/Data input        | Note 6-2  |
| 12    | CSB    | Serial communication chip select.              | Note 6-1  |
| 13    | SCL    | Serial communication clock input.              |           |
| 14    | SDA    | Serial communication data input.               |           |
| 15    | VDDIO  | IO voltage supply                              |           |
| 16    | VCC    | Digital/Analog power.                          |           |
| 17    | VSS    | Digital ground                                 |           |
| 18    | VDD    | 1.5V voltage input & output                    |           |
| 19    | VMTP   | OTP program power (10V)                        |           |
| 20    | VSH1   | Positive source voltage                        |           |
| 21    | VGH    | Positive gate voltage                          |           |
| 22    | VSL    | Negative source voltage.                       |           |
| 23    | VGL    | Negative gate voltage.                         |           |
| 24    | VCOM   | VCOM driving voltage                           |           |



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1. Note 6-1: This pin (CSB) is the chip select input connecting to the MCU. The chip is enabled for MCU communication: only when CSB is pulled LOW.

2. Note 6-2: This pin (DC) is Data/Command control pin connecting to the MCU. When the pin is pulled HIGH, the data will be interpreted as data. When the pin is pulled LOW, the data will be interpreted as command.

3. Note 6-3: This pin (RST\_N) is reset signal input. The Reset is active low.

4. Note 6-4: This pin (BUSY\_N) is busy state output pin. When Busy is Low, the operation of chip should not be interrupted and any commands should not be issued to the module. The driver IC will put Busy pin High when the driver IC is working such as: Outputting display waveform; Communicating with digital temperature sensor

5. Note 6-5: This pin (BS) is for 3-line SPI or 4-line SPI selection. When it is "Low", 4-line SPI is selected. When it is "High", 3-line SPI (9 bits SPI) is selected.

6. Note 6-6: We had made Pin 6 and Pin 7 on FPC to be ground.



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## 7. Reference Circuit

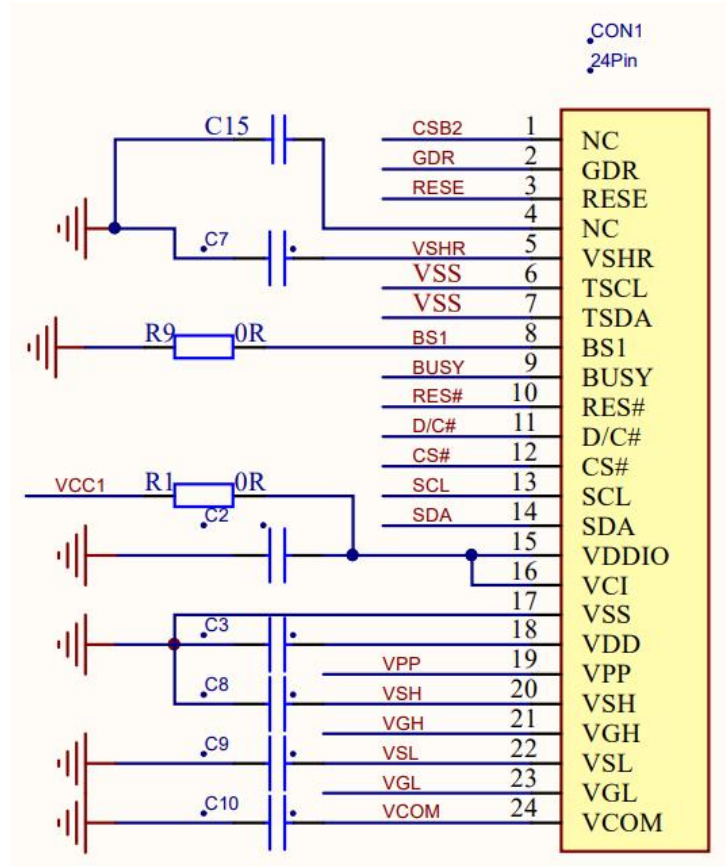


Figure. 7-1

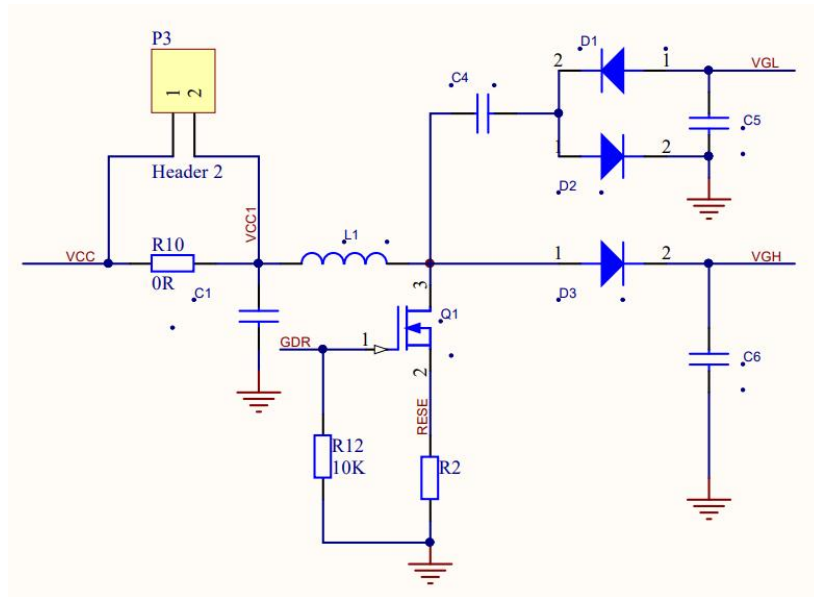


Figure. 7-2



|           |                             |               |          |
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Table. 7-3

| Part Name | Value/Type       | Requirement/Reference Part                                                                                                                                               |
|-----------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C1—C3     | 1uF              | 0603; X5R/X7R; Voltage Rating: 25V                                                                                                                                       |
| C4-C9     | 4.7uF            | 0805; X5R/X7R; Voltage Rating: 25V                                                                                                                                       |
| C10       | 1uF              | 0805; X7R; Voltage Rating: 25V                                                                                                                                           |
| D1—D3     | Diode            | MBR0530<br>1) Reverse DC voltage $\geq$ 30V<br>2) $I_o \geq 500\text{mA}$<br>3) Forward voltage $\leq$ 430mV                                                             |
| R2        | 2.2 $\Omega$     | 0805: 1% variation                                                                                                                                                       |
| Q1        | NMOS             | Si1304BDL/NX3008NBK<br>1) Drain-Source breakdown voltage $\geq$ 30V<br>2) $V_{gs(th)} = 0.9$ (Typ), 1.3V (Max)<br>3) $R_{ds on} \leq 2.1\Omega$ & $V_{gs} = 2.5\text{V}$ |
| L1        | 47uH             | CDRH2D18/LDNP-470NC<br>$I_o = 500$ (Max)                                                                                                                                 |
| CON24Pin  | 0.5mm ZIF Socket | 24Pins, 0.5mm pitch                                                                                                                                                      |



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## 8. ABSOLUTE MAXIMUM RATING

| Parameter                        | Symbol    | Rating   | Unit | Humidity | Unit | Note              |
|----------------------------------|-----------|----------|------|----------|------|-------------------|
| Logic Supply voltage             | VCC,VDDIO | -0.5~6.0 | V    | 45~70    | %RH  | Note 8-1          |
| Operation temperature range      | TOPR      | 0~40     | °C   | 45~70    | %RH  |                   |
| Storage temperature range        | TSTG      | -25~50   | °C   | 45~70    | %RH  | Note 8-2          |
| Transportation temperature range | TTTG      | -25~50   | °C   | 45~70    | %RH  | Note 8-3          |
| GND                              | Ground    | -        | -    |          | -    | Connect to Ground |

Note 8-1: Maximum ratings are those values beyond which damages to the device may occur. VCC: Digital power, VDDIO: IO power. Functional operation should be restricted to the limits in the Electrical Characteristics chapter.

Note 8-2: The display effect may be affected if the product is stored for more than 10days under the environment of 40-60 degree.

Note 8-3: TTTG is the transportation condition, the transport time is within 10 days for -25°C~0°C or 40°C~60°C

Note 8-4: The single pixel effect under the condition of above 35 degree cannot be guaranteed , Normal use is recommended to refresh every 24 hours;

Note 8-5: Due to the nature of FPL,we will not control the display effect of white characters on yellow and yellow characters on white.

## 9. DC Characteristics

The following specifications apply for: VSS=0V, VCC=3.0V, TOPR=25±2°C.

| Symbol  | Parameter                 | Test Condition | Applicable pin  | Min.     | Typ. | Max.     | Unit |
|---------|---------------------------|----------------|-----------------|----------|------|----------|------|
| VCC     | VCC operation voltage     | -              | VCC             | 2.5      | 3.0  | 3.6      | V    |
| VIH     | High level input voltage  | -              | SDA, SCL, CS#,  | 0.8VDDIO | -    | -        | V    |
| VIL     | Low level input voltage   | -              | D/C#, RES#, BS1 | -        | -    | 0.2VDDIO | V    |
| VOH     | High level output voltage | IOH = -100uA   | BUSY,           | 0.9VDDIO | -    | -        | V    |
| VOL     | Low level output voltage  | IOL = 100uA    |                 | -        | -    | 0.1VDDIO | V    |
| Iupdate | Module peak current       | -              | -               | -        | 20   |          | mA   |
| Isleep  | Deep sleep mode           | VCC=3.0V       | -               | -        |      | 5        | uA   |

- The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by XingTai.

- VCOM value will be OTP before in factory.



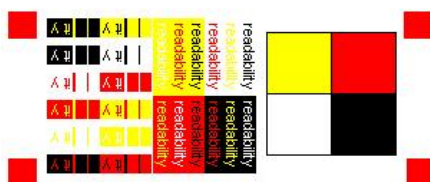
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## 10. Power Consumption

| Parameter                             | Symbol | Conditions | TYP | Max | Unit | Remark |
|---------------------------------------|--------|------------|-----|-----|------|--------|
| Panel power consumption during update | -      | 25°C       |     | 500 | mAs  | -      |

MAs=update Average current ×update time

The Typical power consumption is measured using associated 25°C waveform with following pattern:



## 11. Optical characteristics

### 11.1 Optical Measurement Conditions

| Item                | Symbol     | Value    | Unit | Note           |
|---------------------|------------|----------|------|----------------|
| Ambient Temperature | Ta         | 25±2     | °C   | Indoor testing |
| Ambient Humidity    | Ha         | 50±5     | %RH  | -              |
| Supply Voltage      | VCC, VDDIO | 3.0      | V    | -              |
| illuminance         | -          | 800~1300 | Lux  |                |

Note 11-1: Image is updated with above condition

### 11.2 Optical Measurement

WS: White state, BS: Black state, RS: Red state, YS: Yellow State

Note 11-2: Luminance meter: Eye - One Pro Spectrophotometer

Note 11-3: We don't guarantee 2 years pixels display quality for humidity below 45%RH or above 70%RH; Suggest Updated once a day;

Note 11-4: To increase the black and white screen clear screen when red and yellow has refreshed for a long time, the effect is better.

Note 11-5: Due to the poor consistency, the white text of 1x1 dot in the yellow background and the yellow text of 1x1 dot in the white background cannot be guaranteed in terms of display effect.



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## 11.3 Specifications

T=25℃ ,VDD=3.3V

| SYMBOL | PARAMETER             | CONDITIONS                 | MIN | TYP.                       | MAX      | UNIT | Note      |
|--------|-----------------------|----------------------------|-----|----------------------------|----------|------|-----------|
| R      | Reflectance           | White                      | 30  | 35                         | -        | %    | Note 11-3 |
| Gn     | 2Grey Level           | -                          | -   | $KS+(WS-KS) \times n(m-1)$ | -        | L*   | -         |
| CR     | Contrast Ratio        | -                          | -   | 20                         | -        | -    | -         |
| KS     | Black State L* value  | -                          | -   | 9                          | 14       | -    | Note 11-3 |
|        | Black State a* value  | -                          | -   | -                          | 8        | -    | Note 11-3 |
|        | Black State b* value  | -                          | -   | -                          | 2        | -    | Note 11-3 |
| WS     | White State L* value  | -                          | 60  | 65                         | -        | -    | Note 11-3 |
|        | White State a* value  | -                          | -   | 0                          | 1        | -    | Note 11-3 |
|        | White State b* value  | -                          | -   | -                          | $\leq 3$ | -    | Note 11-3 |
| RS     | Red State L* value    | Red                        | 23  | 26                         | 29       | -    | Note 11-3 |
|        | Red State a* value    | Red                        | 36  | -                          | -        | -    | Note 11-3 |
|        | Red State b* value    | Red                        | -   | -                          | 35       | -    | Note 11-3 |
| YS     | Yellow State L* value | Yellow                     | 53  | 58                         | 63       | -    | Note 11-3 |
|        | Yellow State a* value | Yellow                     | -   | -                          | 20       | -    | Note 11-3 |
|        | Yellow State b* value | Yellow                     | 59  | 68                         | -        | -    | Note 11-3 |
| Panel  | Image Update          | Storage and transportation | -   | Update the white screen    | -        | -    | -         |
|        | Update Time           | Operation                  | -   | Suggest Updated once a day | -        | -    | -         |

WS : White state, KS : Black State, RS: Red State, YS : Yellow State

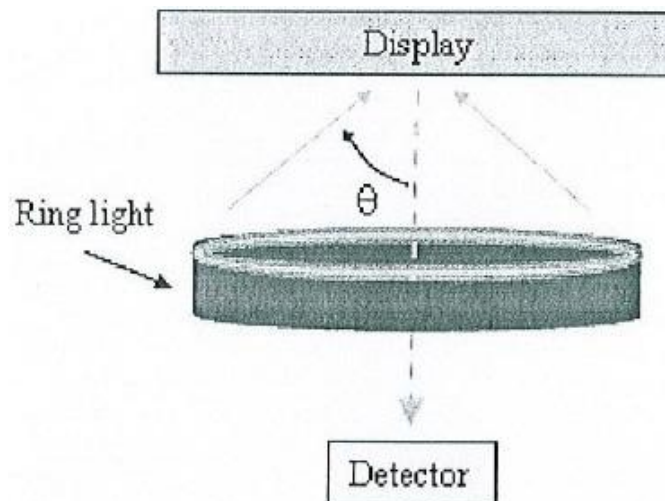
Note 11-3: Luminance meter : i - One Pro Spectrophotometer



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## 11.3 Definition of contrast ratio

The contrast ratio (CR) is the ratio between the reflectance in a full white area (Rl) and the reflectance in a dark area (Rd): Rl: white reflectance Rd: dark reflectance  
$$CR = Rl/Rd$$

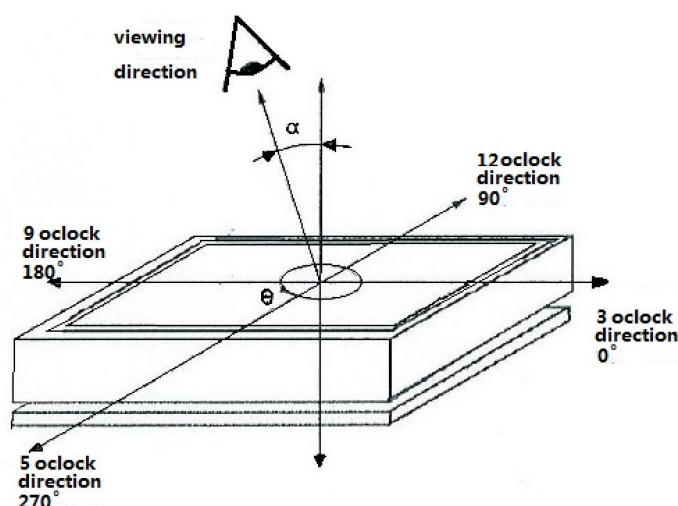


## 11.4 Reflection Ratio

The reflection ratio is expressed as:

$R = \text{Reflectance Factor white board} \times (L_{\text{center}} / L_{\text{white board}})$

$L_{\text{center}}$  is the luminance measured at center in a white area ( $R=G=B=1$ ).  $L_{\text{white board}}$  is the luminance of a standard white board. Both are measured with equivalent illumination source. The viewing angle shall be no more than 2 degrees.





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## 12. Handling Safety and Environmental Requirements

### WARNING

The display module should be kept flat or fixed to a rigid, curved support with limited bending along the long axis. It should not be used for continual flexing and bending. Handle with care. Should the display break do not touch any material that leaks out. In case of contact with the leaked material then wash with water and soap.

### CAUTION

The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronic components.

Disassembling the display module can cause permanent damage and invalidate the warranty agreements.

IPA solvent can only be applied on active area and the back of a glass. For the rest part, it is not allowed.

Observe general precautions that are common to handling delicate electronic components. The glass can break and front surfaces can easily be damaged. Moreover the display is sensitive to static electricity and other rough environmental conditions.

### Mounting Precautions

(1) It's recommended that you consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module.

(2) It's recommended that you attach a transparent protective plate to the surface in order to protect the EPD. Transparent protective plate should have sufficient strength in order to resist external force.

(3) You should adopt radiation structure to satisfy the temperature specification.

(4) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the PS at high temperature and the latter causes circuit break by electro-chemical reaction.

(5) Do not touch, push or rub the exposed PS with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of PS for bare hand or greasy cloth. (Some cosmetics deteriorate the PS)

(6) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach the PS. Do not use acetone, toluene and alcohol because they cause chemical damage to the PS.

(7) Wipe off saliva or water drops as soon as possible. Their long time contact with PS causes deformations and color fading.



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|                       |                                                       |
|-----------------------|-------------------------------------------------------|
| Data sheet status     |                                                       |
| Product specification | The data sheet contains final product specifications. |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Limiting values                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. |
| Application information                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Where application information is given, it is advisory and does not form part of the specification.                                                                                                                                                                                                                                                                                                                                                    |

|                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Environmental certification                                                                                                                                                                                                                                                 |
| ROHS                                                                                                                                                                                                                                                                                |
| REMARK                                                                                                                                                                                                                                                                              |
| All The specifications listed in this document are guaranteed for module only. Post-assembled operation or component(s) may impact module performance or cause unexpected effect or damage and therefore listed specifications is not warranted after any Post-assembled operation. |



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## 13. Reliability test

### 13.1 Reliability test items

|    | TEST                                      | CONDITION                                                                                                        | METHOD                   | REMARK |
|----|-------------------------------------------|------------------------------------------------------------------------------------------------------------------|--------------------------|--------|
| 1  | High-Temperature Operation                | T=40°C, RH=35%RH, For 240Hr                                                                                      |                          |        |
| 2  | Low-Temperature Operation                 | T = 0°C for 240 hrs                                                                                              |                          |        |
| 3  | High-Temperature Storage                  | T=50°C RH=35%RH For 240Hr<br>Test in white pattern                                                               |                          |        |
| 4  | Low-Temperature Storage                   | T = -25°C for 240 hrs<br>Test in white pattern                                                                   |                          |        |
| 5  | High Temperature, High-Humidity Operation | T=40°C, RH=90%RH, For 168Hr                                                                                      |                          |        |
| 6  | High Temperature, High-Humidity Storage   | T=50°C, RH=90%RH, For 240Hr<br>Test in white pattern                                                             |                          |        |
| 7  | Temperature Cycle                         | -25°C(30min)~60°C(30min), 50 Cycle<br>Test in white pattern                                                      |                          |        |
| 8  | Package Vibration                         | 1.04G, Frequency : 10~500Hz<br>Direction : X,Y,Z<br>Duration: 1 hours in each direction                          | Full packed for shipment |        |
| 9  | Package Drop Impact                       | Drop from height of 100 cm on Concrete surface<br>Drop sequence: 1 corner, 3 edges, 6 face<br>One drop for each. | Full packed for shipment |        |
| 10 | UV exposure Resistance                    | 765 W/m <sup>2</sup> for 168hrs, 40°C                                                                            |                          |        |
| 11 | Electrostatic Effect(non-operating)       | Machine model: +/-250V, 0Ω, 200pF                                                                                |                          |        |

Actual EMC level to be measured on customer application.

Note1: Stay white pattern for storage and non-operation test.

Note2: Power off duration time is 150s

Note3: Continue testing after 2 hours at 20C~25C°C

### 13.2 Product life time

The EPD Module is designed for a 2-year life-time with 25 °C/60%RH operation assumption. Reliability estimation testing with accelerated life-time theory would be demonstrated to provide confidence of EPD lifetime.

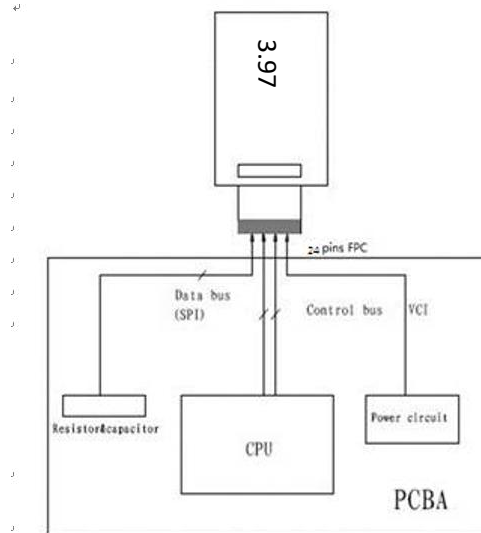
### 13.3 Product warranty

Warranty conditions have to be negotiated between Xingtai and individual customers. Xingtai provides 12+1(one month delivery time) months warranty for all products which are purchased from Xingtai.



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## 14. Block Diagram



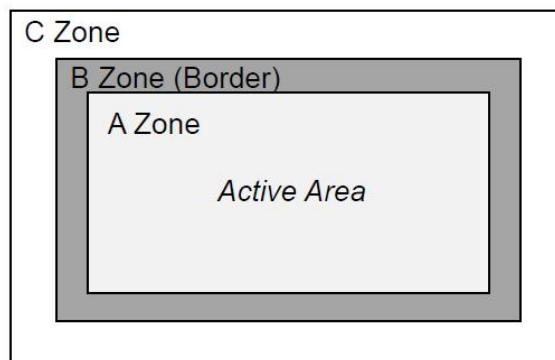
## 15. Shipment inspection specification

### 15.1 Zone Definition

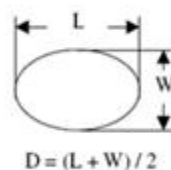
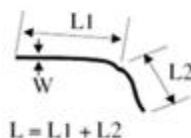
A Zone: Active Area

B Zone: Border Area

C Zone: From B Zone edge to panel edge



### 15.2 Line/Spot defect size





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## 15.3 Point and line standard

| Shipment Inspection Standard                    |                                                          |                                                                                     |             |                                                                                       |        |             |
|-------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------|--------|-------------|
| Equipment: Electrical test fixture, Point gauge |                                                          |                                                                                     |             |                                                                                       |        |             |
| Outline dimension                               | 56.24(H)*96.62(V)<br>*0.4(D)                             | Unit: mm                                                                            | Part-A      | Active area                                                                           | Part-B | Border area |
|                                                 |                                                          |                                                                                     |             |                                                                                       |        |             |
| Environment                                     | Temperature                                              | Humidity                                                                            | illuminance | Distance                                                                              | Time   | Angle       |
|                                                 | 19℃~25℃                                                  | 50±5%RH                                                                             | 800~1300Lux | 300 mm                                                                                | 35Sec  | 45°         |
|                                                 |                                                          |                                                                                     |             |                                                                                       |        |             |
| Defect type                                     | Inspection method                                        | Standard                                                                            |             | Part-A                                                                                | Part-B |             |
| Spot                                            | Electric Display                                         | D≤0.25 mm                                                                           |             | Ignore                                                                                | Ignore |             |
|                                                 |                                                          | 0.25 mm<D≤0.4 mm                                                                    |             | N≤4                                                                                   | Ignore |             |
|                                                 |                                                          | D>0.4 mm                                                                            |             | Not Allow                                                                             | Ignore |             |
| Display malfunction                             | Electric Display                                         | Not Allow                                                                           |             | Not Allow                                                                             | Ignore |             |
| Display error                                   | Electric Display                                         | Not Allow                                                                           |             | Not Allow                                                                             | Ignore |             |
| Scratch or line defect(include dirt)            | Visual/Film card                                         | L≤2 mm,W≤0.2 mm                                                                     |             | Ignore                                                                                | Ignore |             |
|                                                 |                                                          | 2.0mm<L≤5.0mm,0.2<W≤0.3mm,                                                          |             | N≤2                                                                                   | Ignore |             |
|                                                 |                                                          | L>5 mm,W>0.3 mm                                                                     |             | Not Allow                                                                             | Ignore |             |
| PS Bubble                                       | Visual/Film card                                         | D≤0.2mm                                                                             |             | Ignore                                                                                | Ignore |             |
|                                                 |                                                          | 0.2mm≤D≤0.35mm                                                                      |             | N≤4                                                                                   | Ignore |             |
|                                                 |                                                          | D>0.35 mm                                                                           |             | Not Allow                                                                             | Ignore |             |
| Corner /Edge chipping                           | Visual/Film card                                         | X≤6mm,Y≤0.4mm, Do not affect the electrode circuit (Edge chipping)                  |             |                                                                                       |        |             |
|                                                 |                                                          | X≤1mm,Y≤1mm, Do not affect the electrode circuit( (Corner chipping)                 |             |                                                                                       |        |             |
|                                                 |                                                          | Ignore                                                                              |             |                                                                                       |        |             |
|                                                 |                                                          |  |             |   |        |             |
| TFT warping                                     | For 1.54~7.5inch, T≤2mm; For above 7.5inch, T≤3mm        |                                                                                     |             |  |        |             |
| Remark                                          | 1.Cannot be defect & failure cause by appearance defect; |                                                                                     |             |                                                                                       |        |             |
|                                                 | 2.Cannot be larger size cause by appearance defect;      |                                                                                     |             |                                                                                       |        |             |
|                                                 | L=long      W=wide      D=point size      N=Defects NO   |                                                                                     |             |                                                                                       |        |             |



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## 15.4 Barcode



What is the QR code after picture being scanned and read? It consist of 30 numbers and letters, here is explanation for it.

QR Code: ABBBBBBBBBBFFCCDDDEEEEGHIJKLL

- ① A means Factory code, e.g.: H (HINK)
- ② BBBBBBBBBB refers to product model name, which is in consistent with specification part number. E.g.: E0213A189 or E0266A120; when the total code is less than 9, it would be added suffix with \*\*. e.g.: E027A45\*\* or E0154A78\*
- ③ FF means production workshop
- ④ CCC means date of production
- ⑤ DDD means production batch
- ⑥ EEEE means FPL lot
- ⑦ G means MP/Sample/Trial/Repair
- ⑧ HIJ:(H——TFT;I——PS;J——EC Glue)
- ⑨ KK means IC type
- ⑩ LL means serial number



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## 16. Packing

Full carton: 12 pcs tray with products and 1 pcs empty tray.

Last carton: less 12pcs tray with products and 1 pcs empty tray. The packager will add the right amount of EPE to box so that the added EPE's height approximately close to the EPE height around the inside of the box.

