

# SPECIFICATION FOR AMOLED Module

|            |                      |
|------------|----------------------|
| MODULE No: | ID-021WVOSN009-C003B |
| CUSTOMER:  |                      |

|             |         |      |
|-------------|---------|------|
| I-DISPALY   | INITIAL | DATE |
| PREPARED BY |         |      |
| CHECKED BY  |         |      |
| APPROVED BY |         |      |

|             |         |      |
|-------------|---------|------|
| CUSTOMER    | INITIAL | DATE |
| APPROVED BY |         |      |

## Revision History

[illegible]

|          |                      |     |      |              |
|----------|----------------------|-----|------|--------------|
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\* **Description**

This is a color active matrix AMOLED module using Low Temperature Poly-silicon Thin Film Transistors as active switching devices. This module has a 2.14 inch diagonally measured active area with 480 horizontal by 480 vertical pixel arrays. Each pixel is divided into RED and GREEN dots, or BLUE and GREEN dots, and two pixels share RED or BLUE dots which are arranged in vertical stripe and this module can display colors.

\* **Features**

| General Information Items | Specification                 | Unit    | Note |
|---------------------------|-------------------------------|---------|------|
|                           | Main Panel                    |         |      |
| Display area(AA)          | 38.39(H)*38.39(V) (2.14 inch) | mm      |      |
| Driver element            | TFT active matrix             | -       |      |
| Number of pixels          | 480(RGB)*480                  | dots    |      |
| Viewing angle             | ALL                           | o'clock |      |
| Controller IC             | CO5300AF                      | -       |      |
| Touch Controller IC       | CST9220(On cell)              | -       |      |
| LCM Interface             | QSPI                          | -       |      |
| Display mode              | AMOLED                        | -       |      |
| Operating temperature     | -20~+60                       | ℃       |      |
| Storage temperature       | -30~+70                       | ℃       |      |

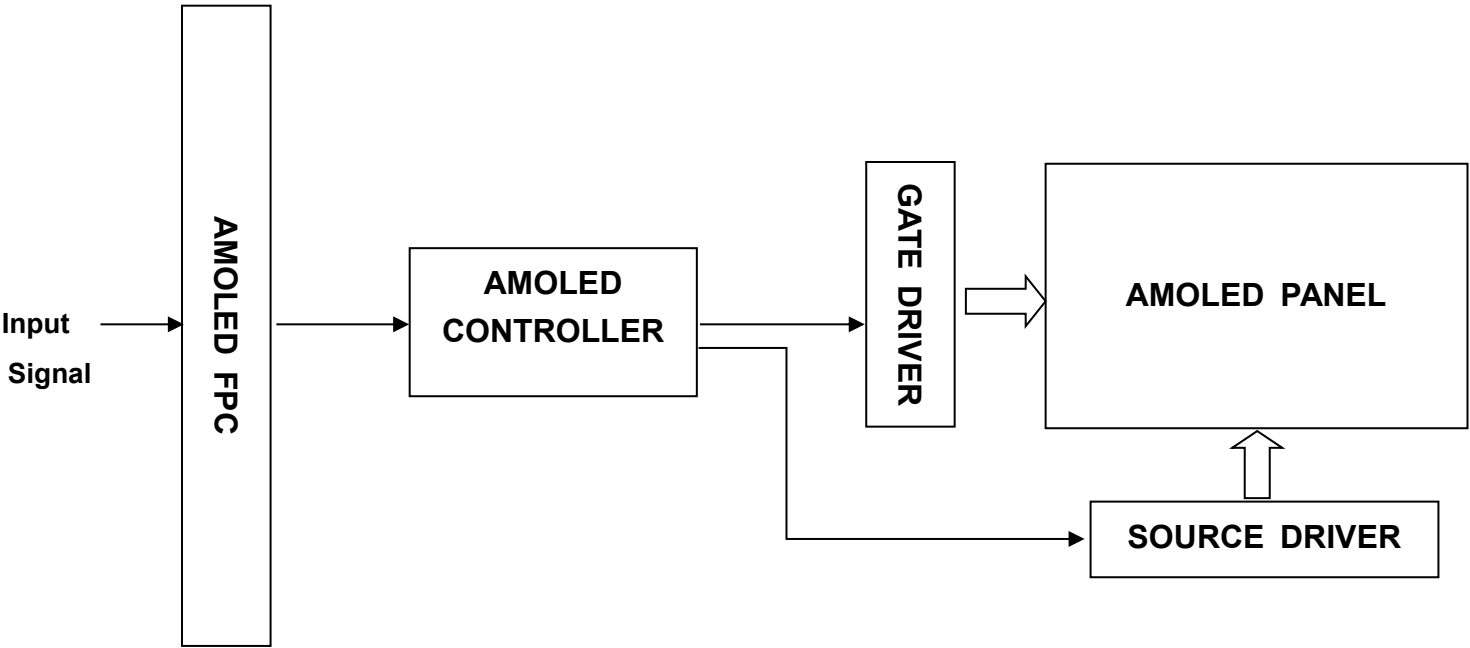
\* **Mechanical Information**

| Item        |               | Min. | Typ.  | Max. | Unit | Note |
|-------------|---------------|------|-------|------|------|------|
| Module size | Horizontal(H) |      | 42.39 |      | mm   | -    |
|             | Vertical(V)   |      | 42.39 |      | mm   | -    |
|             | Depth(D)      |      | 2.55  |      | mm   | -    |
| Weight      |               |      | 11    |      | g    | -    |

LENS Features

| General Information Items | Specification | Unit | Note |
|---------------------------|---------------|------|------|
|                           | Main Panel    |      |      |
| Material                  | Glass         | -    |      |
| Surface hardness          | ≥6H           | -    |      |
| Surface treatment         | AF            | -    |      |

1. Block Diagram



|          |                      |     |      |              |
|----------|----------------------|-----|------|--------------|
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3. Input terminal Pin Assignment

| NO. | SYMBOL      | DISCRIPTION                                                                                                                                      | I/O |
|-----|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1   | GND         | Ground                                                                                                                                           | P   |
| 2   | TP_INT      | CTP INT                                                                                                                                          | I   |
| 3   | TP_SDA      | CTP I2C Data                                                                                                                                     | I   |
| 4   | TP_SCL      | CTP I2C CLK                                                                                                                                      | I   |
| 5   | TP_VCC_3.3V | Power Supply for TP                                                                                                                              | P   |
| 6   | TP_RST      | CTP RESET                                                                                                                                        | I   |
| 7   | GND         | Ground                                                                                                                                           | P   |
| 8   | LCD_3.3V    | Power Supply for Analog Circuits                                                                                                                 | P   |
| 9   | LCD_3.3V    | Power Supply for Analog Circuits                                                                                                                 | P   |
| 10  | VBAT        | Power Supply for POWER IC                                                                                                                        | P   |
| 11  | AVDD_EN     | Power Supply enabled                                                                                                                             | P   |
| 12  | GND         | Ground                                                                                                                                           | P   |
| 13  | GND         | Ground                                                                                                                                           | P   |
| 14  | LCD_RST     | Display driver reset, must be applied to properly initialize the chip. Signal is active low.                                                     | I   |
| 15  | QSPI_CS     | Chip Select Signal in MIPI DBI Type-B(MPU) and Type-C(SPI) Active Low                                                                            | I   |
| 16  | QSPI_SI00   | Serial Data Input in Quad-SPI                                                                                                                    | I   |
| 17  | QSPI_SI01   |                                                                                                                                                  | I   |
| 18  | GND         | Ground                                                                                                                                           | P   |
| 19  | QSPI_CLK    | Serial Clock Input in Quad-SPI                                                                                                                   | I   |
| 20  | GND         | Ground                                                                                                                                           | P   |
| 21  | QSPI_SI02   | Serial Data Input in Quad-SPI                                                                                                                    | I   |
| 22  | QSPI_SI03   |                                                                                                                                                  | I   |
| 23  | TE          | Tearing effect output pin to synchronize MCU to frame writing, activated by S/W command. When this pin is not activated, this pin is output low. | O   |
| 24  | MTP/NC      | NC                                                                                                                                               |     |

4. AMOLED Optical Characteristics

4.1 Optical specification

| Item                         |       | Symbol         | Condition     | Min.  | Typ.  | Max.  | Unit. | Note   |
|------------------------------|-------|----------------|---------------|-------|-------|-------|-------|--------|
| Contrast Ratio               |       | CR             | Θ=0<br>Normal | 10000 | --    | --    |       | (1)(2) |
| LCM Luminance                |       | LV             | White Mode    | 500   | 600   | --    | cd/m2 | (5)    |
| Color gamut                  |       | S(%)           | vs. NTSC      | --    | 99    | --    | %     | (1)    |
| Color Filter<br>Chromaticity | White | W <sub>X</sub> |               | -0.04 | 0.300 | +0.04 |       | (1)(4) |
|                              |       | W <sub>Y</sub> |               |       | 0.310 |       |       |        |
|                              | Red   | R <sub>X</sub> |               |       | 0.675 |       |       |        |
|                              |       | R <sub>Y</sub> |               |       | 0.326 |       |       |        |
|                              | Green | G <sub>X</sub> |               |       | 0.221 |       |       |        |
|                              |       | G <sub>Y</sub> |               |       | 0.693 |       |       |        |
|                              | Blue  | B <sub>X</sub> |               |       | 0.140 |       |       |        |
|                              |       | B <sub>Y</sub> |               |       | 0.040 |       |       |        |
| OLED Life Time               |       |                |               | 30000 | --    | --    | Hrs   |        |
| Option View                  |       | ALL            |               |       |       |       |       |        |

\*The data comes from the AMOLED specification.

Measuring Condition

Measuring surrounding : dark room

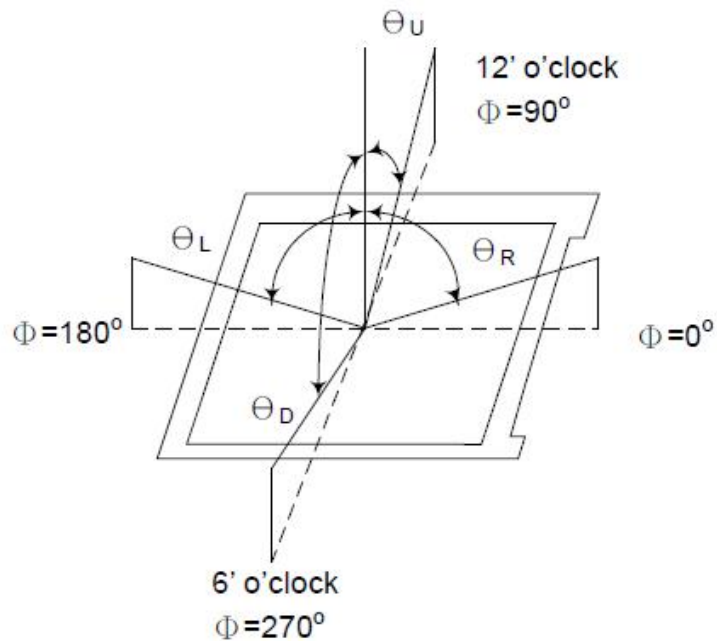
Ambient temperature : 25±2°C

15min. warm-up time.

Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

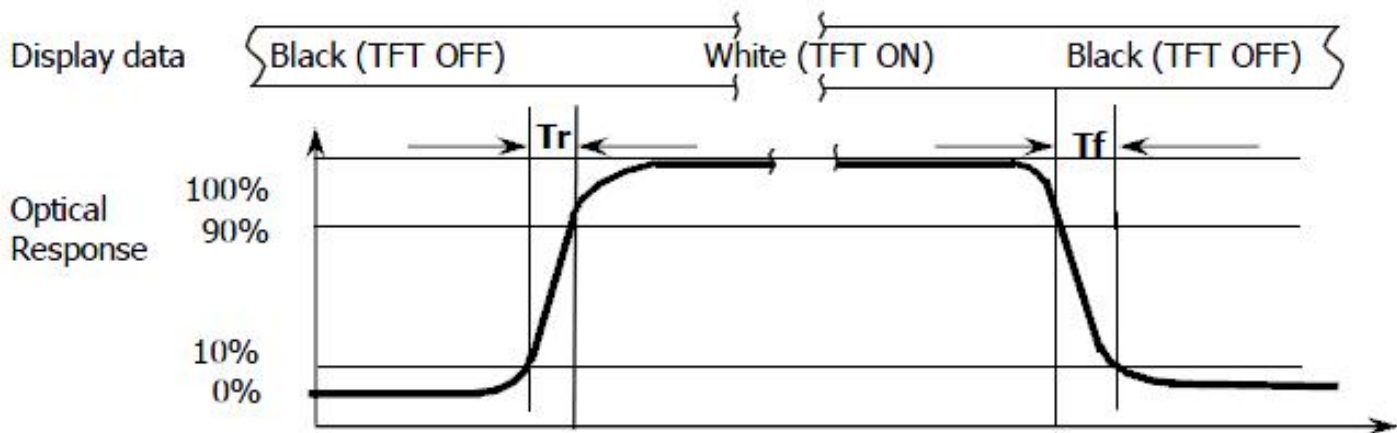
**Note (1):** Definition of Viewing Angle :



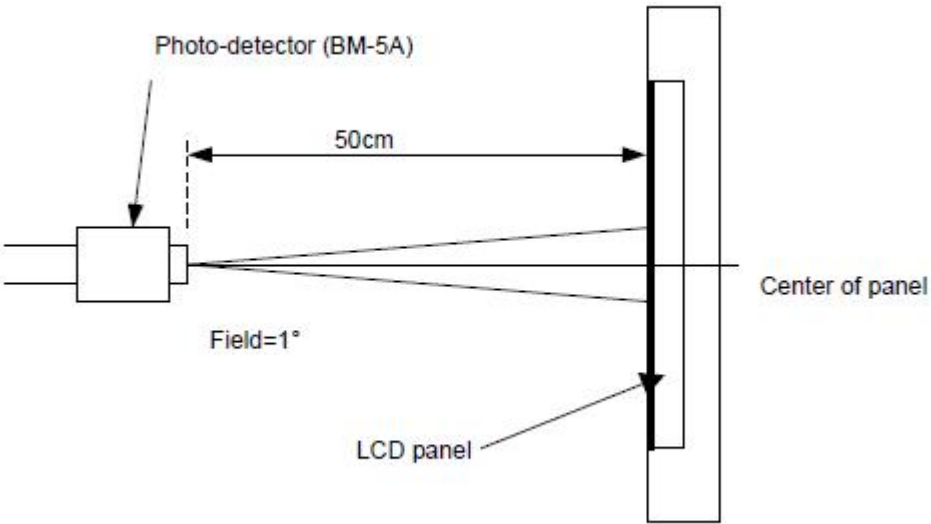
**Note (2):** Definition of Contrast Ratio(CR) :measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

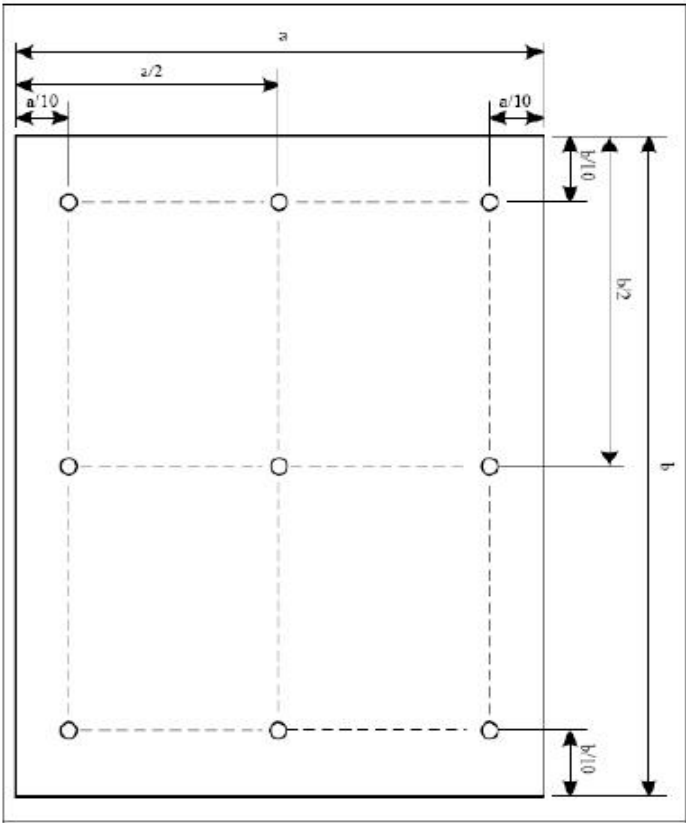
**Note (3):** Response Time



**Note (4):** Definition of optical measurement setup



NOTE (5): Luminance Uniformity of these 9 points is defined as below:



$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

5. AMOLED Electrical Characteristics

5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

| Characteristics       | Symbol          | Min. | Max. | Unit |
|-----------------------|-----------------|------|------|------|
| Analog Power supply   | LCD_3.3V        | 0    | 5.5  | V    |
| Power supply          | VABT            | 0    | 5.0  |      |
| Operating temperature | T <sub>OP</sub> | -20  | +60  | °C   |
| Storage temperature   | T <sub>ST</sub> | -30  | +70  | °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.

5.2 DC Electrical Characteristics

| Characteristics     | Symbol            | Min. | Typ. | Max. | Unit | Note |
|---------------------|-------------------|------|------|------|------|------|
| Analog Power Supply | LCD_3.3V          | 2.5  | 3.0  | 3.6  | V    | --   |
| Current (display)   | I <sub>VCC</sub>  | --   | 4.0  | 10   | mA   | (1)  |
| Power IC Supply     | VBAT              | 3.45 | 3.7  | 5    | V    | --   |
| Current (VBAT)      | I <sub>VBAT</sub> | --   | 70   | 150  | mA   | (1)  |

Note1: Test conditions: VBAT=3.7V,VCC=3.3V,White screen, maximum brightness test

6. AC Characteristic

6.1 Write Cycle and Sequence

The QUAD SPI interface write command sequences are described in the following figure as below.

QSPI write protocol contain as below :

Instruction[7:0] = 02h

AD[23:0] = {8'h00, CMD[7:0], 8'h00}

PAM[7:0]

Command write

Driver IC command address

Driver IC parameters

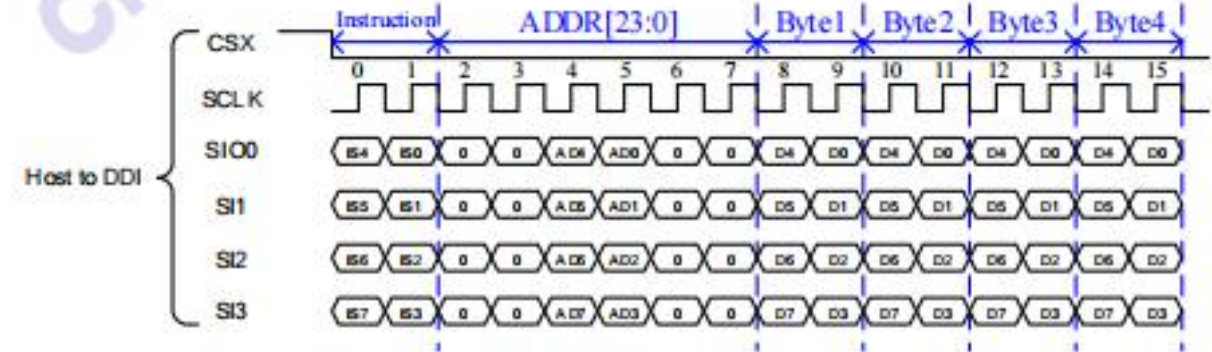
QSPI 1-wire write



QSPI 2-wire write



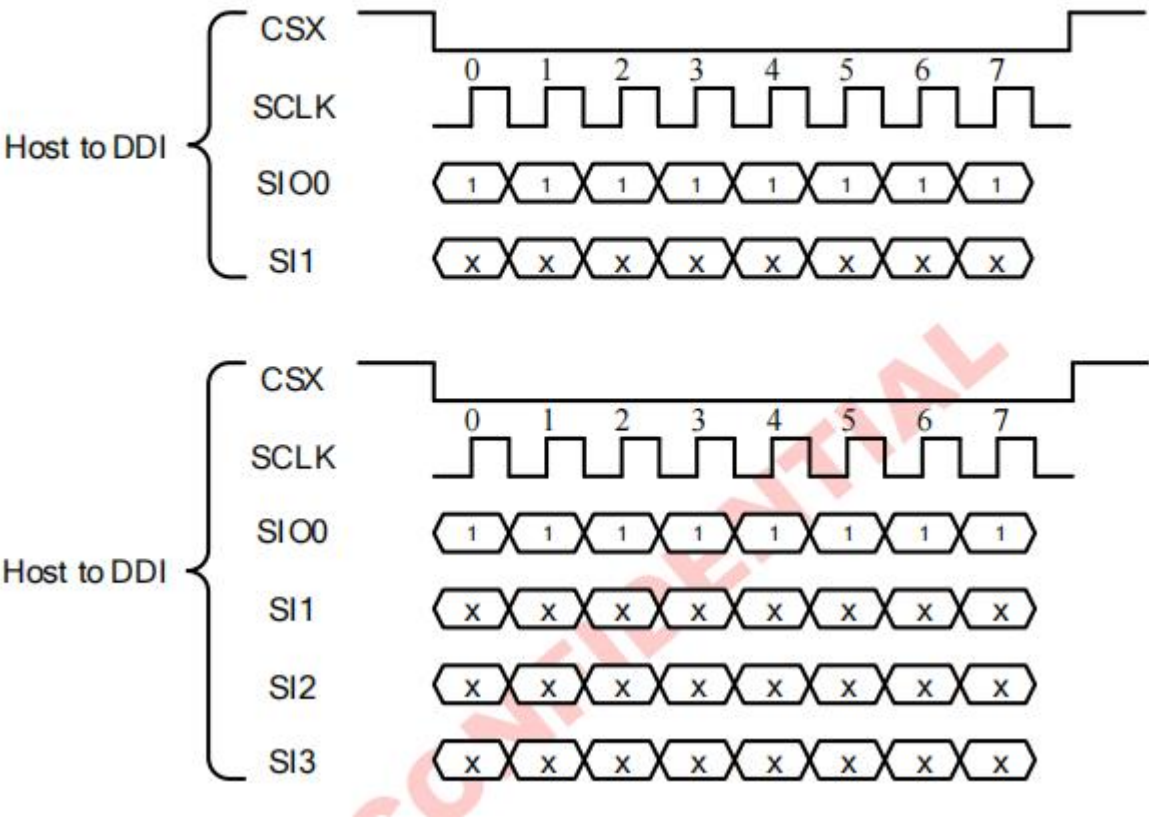
QSPI 4-wire write



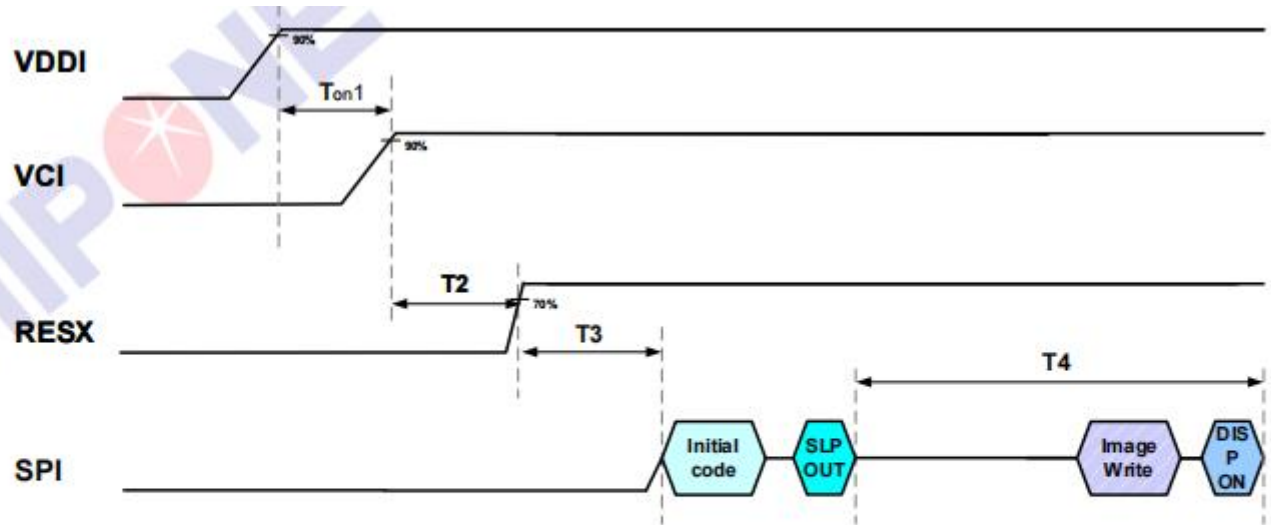
6.2 Reset Function

2.Reset Function

If the host is operating in 1-wire SPI protocol and the driver IC is operating in 2-wire or 4-wire SPI protocol, then the DDIC interface is reset to 1-wire SPI.



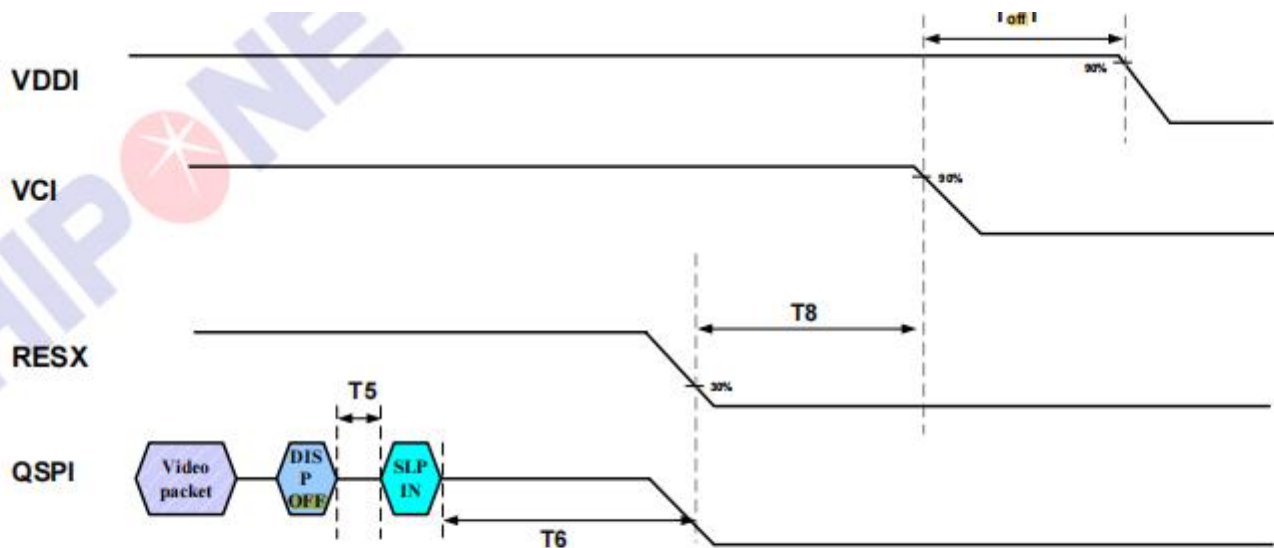
6.3 Power ON Sequence



SPI Power ON Sequence

- Note 1:** Unless otherwise specified, timings herein show cross point at 50% of signal/power level.
- Note 2:** This power-on sequence is based on adding Schottky diode on VGL pin to ground.

6.4 Power off Sequence



QSPI Power off sequence

- Note 1:** Unless otherwise specified, timings herein show cross point at 50% of signal/power level.
- Note 2:** Keep VGH is equal to or larger than VCI during power off sequence.

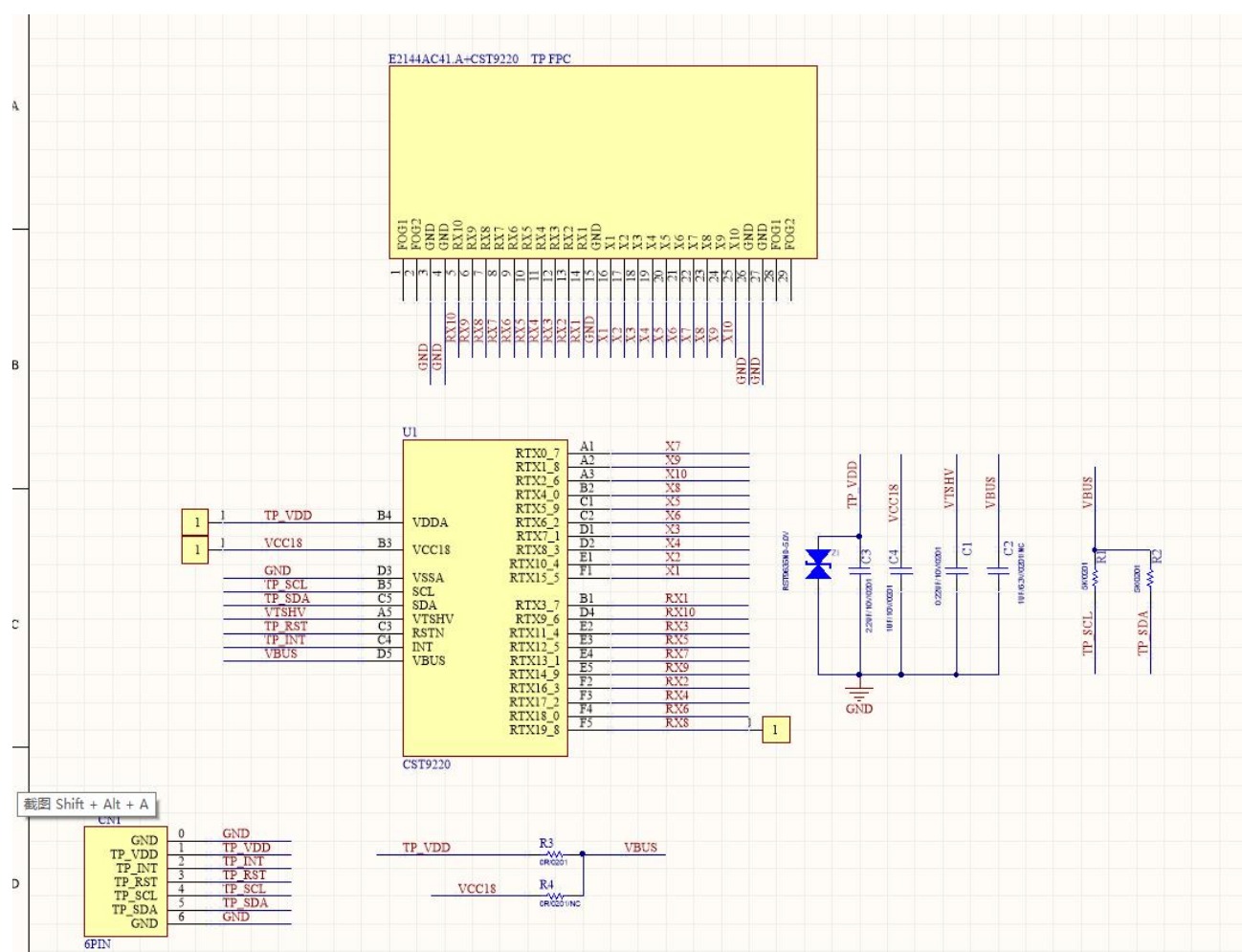
7. Touch Specification

7.1 Electrical Characteristics

7.1.1 Absolute Maximum Rating

| Item                  | Symbol          | Min. | Max. | Unit | Note |
|-----------------------|-----------------|------|------|------|------|
| TP power supply Input | TP_VCC          | 0    | 3.6  | V    |      |
| Operating temperature | T <sub>OP</sub> | -20  | +60  | ℃    |      |
| Storage temperature   | T <sub>ST</sub> | -30  | +70  | ℃    |      |

7.2 Touch Part Schematic



## 8. Quality Level

### 8.1 Standard

According to GB/T2828.1-2003/ISO 2859-1:1999 and ANSI/ASQC Z1.4-1993, General Inspection Level II and based on Major Defect: AQL 0.65, Minor Defect: AQL 1.5.

### 8.2 Definition

- 1) Major Defect: The defect that greatly affect the usability of product.
- 2) Minor Defect: The other defects, such as cosmetic defects, etc.
- 3) Definition of Inspection Zone 检验区的定义:

Zone A: Active Area

Zone B: Viewing Area except Zone A Zone

C: Outside Viewing Area

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble of quality and assembly to customer`s product.

### 8.3 Inspection Methods

1. General Inspection: under 20W x 2 or 40W fluorescent light(1000+200LUX), about 30cm viewing distance, within 45° viewing angle, under 25±5℃.

Inspection Pattern: Red/Green/Blue/White/Black/128 gray scale

2. The Brightness and Color Coordinate Inspection: By CS2000/09A-OLED-117 or the equal equipment, in the dark room, under 25±5℃.

9. Reliability Test Result

| Item                                     | Condition                                                                                                      | Inspection after test                                                                                                                                                                                                                                       |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High Temperature Operating               | 60°C,96H                                                                                                       | Inspection after 2~4hours<br>storage at room temperature, the<br>sample shall be free from<br>defects:<br>1.Air bubble in the OLED;<br>2.Non-display;<br>3.Missing segments/line;<br>4.Glass crack;<br>5.Current IDD is twice higher<br>than initial value. |
| Low Temperature Operating                | -20°C, 96HR                                                                                                    |                                                                                                                                                                                                                                                             |
| High Temperature Storage                 | 70°C, 96HR                                                                                                     |                                                                                                                                                                                                                                                             |
| Low Temperature Storage                  | -30°C, 96HR                                                                                                    |                                                                                                                                                                                                                                                             |
| High Temperature & High Humidity Storage | +60°C, 90% RH ,96 hours.                                                                                       |                                                                                                                                                                                                                                                             |
| Thermal Shock (Non-operation)            | -20°C,30 min ↔ 60°C,30 min,<br>Change time:5min 20CYC.                                                         |                                                                                                                                                                                                                                                             |
| ESD test                                 | C=150pF, R=330,5points/panel<br>Air:±4KV, 5times; Contact:±4KV, 5 times;<br>(Environment: 15°C~35°C, 30%~60%). |                                                                                                                                                                                                                                                             |

- Remark:
- 1.The test samples should be applied to only one test item.
  - 2.Sample size for each test item is 5~10pcs.
  - 3.For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.
  - 4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
  - 5.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.
  - 6. The color fading mura of polarizing filter should not care.

# 10. Cautions and Handling Precautions

## 10.1 Handling Precautions:

- (1)The display panel is made of glass and polarizer. As glass is fragile. It tends to become chipped during handling especially on the edges. Please avoid dropping or jarring. Do not subject it to a mechanical shock by dropping it or impact.
- (2) Do not apply excessive force to the display surface or the adjoining areas since this may cause abnormal. Do not touch the display with bare hands. This will stain the display area (some cosmetics are determined to the polarizer).
- (3) The polarizer covering the display surface of the OLED module is soft and easily scratched. Handle this polarizer carefully. Donot touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on it. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming in to contact with room temperature air.
- (4) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents.
- Isopropyl alcohol
  - Ethyl alcohol
- Do not scrub hard to avoid damaging the display surface.
- (5) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
- Water
  - Ketone
  - Aromatic solvents
- Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contact with oil and fats.
- (6) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- (7) When mounting the OLED module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable.
- (8) Do not attempt to disassemble or process the OLED module.
- (9) NC terminal should be open. Do not connect anything.
- (10) If the logic circuit power is off, do not apply the input signals.
- (11) To protect the display surface, the AMOLED Module is coated with a film. Be careful when peeling off this protective film, because static electricity may generate.

11. Packing

----TBD-----