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**MODEL NO : ET048HD01-S****MODEL VERSION: 01****SPEC VERSION : 1.0****ISSUED DATE: 2018-11-05**☒ **Preliminary Specification**☐ **Final Product Specification****Customer :** \_\_\_\_\_

| Approved by | Notes |
|-------------|-------|
|             |       |

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## Record of Revision

[illegible]

## 1 General Specifications

| Feature                           |                        | Spec                         |
|-----------------------------------|------------------------|------------------------------|
| <b>Display Spec.</b>              | Size                   | 4.8 inch                     |
|                                   | Resolution             | 720(RGB) X 1280              |
|                                   | Technology Type        | a-Si                         |
|                                   | Pixel Configuration    | RGB Vertical Stripe          |
|                                   | Pixel pitch(mm)        | 0.0275 (W) ×0.0825 (H)       |
|                                   | Display Mode           | Normally Black, Transmissive |
|                                   | Viewing Direction      | ALL                          |
| <b>Mechanical Characteristics</b> | MODEL (W x H x D) (mm) | 63.2 (W) ×115.5(H) ×1.62 (D) |
|                                   | LCD Active Area(mm)    | 59.4(W)×105.6(H)             |
|                                   | Weight (g)             | TBD                          |
| <b>Electrical Characteristics</b> | LCD Interface          | MIPI 4 lane                  |
|                                   | Driver IC              | BU76S28                      |
|                                   | Color Depth            | 16.7M                        |

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180 degree shift.

Note 2: Requirements on Environmental Protection: Q/S0002

Note 3: LCM weight tolerance: ± 5%

## 2 Input/Output Terminals

### 2.1 LCM Interface

| Pin No | Symbol        | Description                      | I/O | Remarks |
|--------|---------------|----------------------------------|-----|---------|
| 1      | D3P           | MIPI data signal line (+)        | I/O |         |
| 2      | D3N           | MIPI data signal line (-)        | I/O |         |
| 3      | GND           | GND level pin                    | -   |         |
| 4      | D2P           | MIPI data signal line (+)        | I/O |         |
| 5      | D2N           | MIPI data signal line (-)        | I/O |         |
| 6      | GND           | GND level pin                    | -   |         |
| 7      | CKP           | MIPI clock signal line (+)       | I   |         |
| 8      | CKN           | MIPI clock signal line (-)       | I   |         |
| 9      | GND           | GND level pin                    | -   |         |
| 10     | D1P           | MIPI data signal line (+)        | I/O |         |
| 11     | D1N           | MIPI data signal line (-)        | I/O |         |
| 12     | GND           | GND level pin                    | -   |         |
| 13     | D0P           | MIPI data signal line (+)        | I/O |         |
| 14     | D0N           | MIPI data signal line (-)        | I/O |         |
| 15     | GND           | GND level pin                    | -   |         |
| 16     | GND           | GND level pin                    | -   |         |
| 17     | RESX          | Reset enable pin                 | I   |         |
| 18     | GND           | GND level pin                    | -   |         |
| 19     | VSN           | Power supply for source negative | -   |         |
| 20     | VSP           | Power supply for source positive | -   |         |
| 21     | VDD           | Power supply for analog          |     |         |
| 22     | GND(MAKER ID) | MAKER ID /GND level pin          | -   |         |
| 23     | ERR/NC        | Error signal/NC                  | -   |         |
| 24     | BC            | Display brightness control       | O   |         |
| 25     | OSCIN/GND     | Oscillator input/NC              | -   |         |
| 26     | VDDIO         | Power supply for I/O             | -   |         |
| 27     | GND           | GND level pin                    | -   |         |
| 28     | LED-          | LED cathode                      | -   |         |
| 29     | LED+          | LED anode                        | -   |         |
| 30     | GND           | GND level pin                    | -   |         |

Mounted connector : 30pins; 0.4mm pitch; B to B connector. (PANASONIC- AXT630124)

Corresponded connector : 30pins; 0.4mm pitch; B to B connector. (PANASONIC -AXT530124)

Signals connect to LCD module. Symbols correspond able to Circuit diagram in Page 11.

## 3 Absolute Maximum Ratings

GND=0V

| Item                  | Symbol | MIN  | MAX | Unit | Remark |
|-----------------------|--------|------|-----|------|--------|
| Power Voltage         | VDD    | -0.3 | 5   | V    | Note1  |
| Operating Temperature | Top    | -20  | 60  | °C   |        |
| Storage Temperature   | Tst    | -30  | 70  | °C   |        |

**Table 3 Absolute Maximum Ratings**

Note 1: Temperature and relative humidity range are shown in the figure below.

## 4 Electrical Characteristics

### 4.1 Driving TFT LCD Panel

Table 4

Ta=25 °C, GND=0V

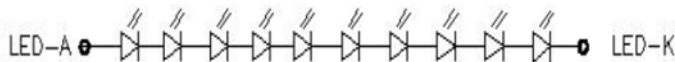
| Parameter                | Symbol          | Conditions   | Min.      | Typ. | Max.      | Unit | Applicable Pin |
|--------------------------|-----------------|--------------|-----------|------|-----------|------|----------------|
| Supply voltage1          | VDD-GND         | Ta=-20~70 °C | 2.7       | 2.85 | 3.0       | V    | (note 1)       |
| Supply voltage2          | VDDIO-GND       | Ta=-20~70 °C | 1.65      | 1.8  | 1.95      | V    |                |
| Supply voltage3          | VSP-GND         | Ta=-20~70 °C | 5.45      | 5.6  | 5.75      | V    | (note 1)       |
| Supply voltage4          | VSP-GND         | Ta=-20~70 °C | -5.25     | -5.4 | -5.55     | V    | (note 1)       |
| "H" level input voltage  | V <sub>IH</sub> | Ta=-20~70 °C | 0.7 VDDIO | -    | VDDIO     | V    | (note 2)       |
| "L" level input voltage  | V <sub>IL</sub> |              | 0         | -    | 0.3VDDIO  | V    |                |
| "H" level Output voltage | V <sub>OH</sub> | Ta=-20~70 °C | 0.8 VDDIO | -    | -         | V    | (note 3)       |
| "L" level Output voltage | V <sub>OL</sub> |              | -         | -    | 0.2 VDDIO | V    |                |

### 4.2 Backlight Unit

The backlight system is an edge-lighting type with 10 LED. The characteristics of the LED are shown in the following tables.

| Item                      | Symbol         | MIN   | TYP | MAX | Unit | Remark  |
|---------------------------|----------------|-------|-----|-----|------|---------|
| Backlight forward voltage | V <sub>F</sub> | -     | 32  | -   | V    | 10 LEDs |
| Backlight forward current | I <sub>F</sub> | --    | 20  | --  | mA   |         |
| LED life time             | --             | 20000 | --  | --  | Hrs  |         |

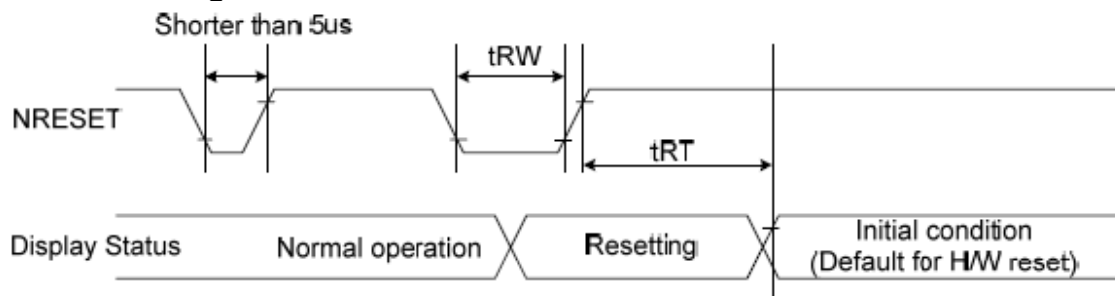
Note 1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 °C, typical IL value indicated in the above table and the fL=50k Hz until the brightness becomes less than 50%.



BACKLIGHT CIRCUIT DIAGRAM 20mA/LED (10LED)  
LED Vf:32V(TYP)

## 5 Timing Chart

### 5.1 Reset Timing



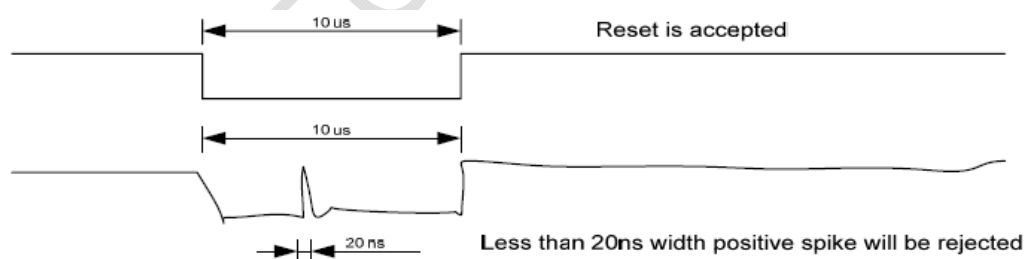
| Signal | Symbol   | Parameter            | Min | Max              | Unit |
|--------|----------|----------------------|-----|------------------|------|
| RESX   | $t_{RW}$ | Reset pulse duration | 10  |                  | us   |
|        | $t_{RT}$ | Reset cancel         |     | 5(note 1,5)      | ms   |
|        |          |                      |     | 120 (note 1,6,7) | ms   |

**Note :** 1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from

| RESX Pulse           | Action         |
|----------------------|----------------|
| Shorter than 5us     | Reset Rejected |
| Longer than 10us     | Reset          |
| Between 5us and 10us | Reset starts   |

2. During Reset Complete Time, OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time ( $t_{REST}$ ) within 50ms after a rising edge of RESX.

3. Spike Rejection also applies during a valid reset pulse as shown below:





## 5.2 Mipi Video Mode Setting 1

I/F: MIPI 4lane

Panel Size : HD720 (720xRGBx1280)

VDD=2.85V+0.15V, VDDIO=1.8V

VSP=5.6V, VSN=-5.4V

Color Mode: 24bit

Panel Driving : 1+2Dots Inversion

Frame frequency: 57Hz(MAX)

| ITEM                             | Setting          | Unit  | REMARK |
|----------------------------------|------------------|-------|--------|
| Resolution                       | 720 x RGB x 1280 | Pixel |        |
| VFP(Vertical Front Porch)        | 2                | H     | *1     |
| VBP(Vertical Back Porch)         | 4                | H     | *1     |
| VSA(Vertical Sync Pulse width)   | 2                | H     | *1     |
| HFP(Horizontal Front Porch)      | 393              | CLK   | *2     |
| HBP(Horizontal Back Porch)       | 14               | CLK   | *2     |
| HSA(Horizontal Sync Pulse width) | 7                | CLK   | *2     |
| Frame Frequency                  | 57               | Hz    | Max    |
| MIPI Lane                        | 4                | Lane  |        |
| HS Clock                         | 500              | Mbps  |        |

\*1 1H=13.598us

\*2 1CLK=12ns

1UI<sub>DST</sub>=2ns

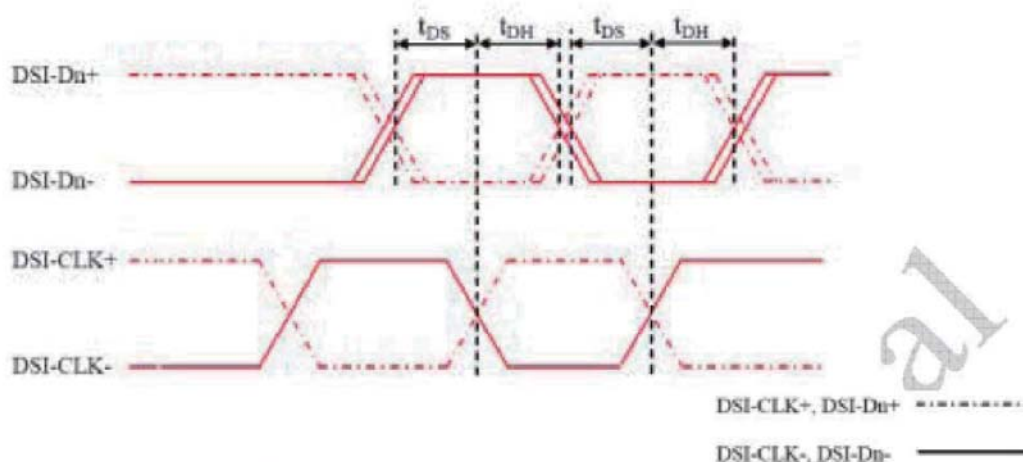


Figure 15.4-4: DSI Data to Clock Channel Timings

Table 15.4-5: DSI Data to Clock Channel Timings

| Signal    | Symbol   | Parameter                | Min  | Max | Unit   |
|-----------|----------|--------------------------|------|-----|--------|
| DSI-Dn+/- | $t_{DS}$ | Data to Clock Setup Time | 0.15 | -   | UIINST |
| DSI-Dn+/- | $t_{DH}$ | Clock to Data Hold Time  | 0.15 | -   | UIINST |

### 5.3 Initial Sequence

#### 1) POWER ON Sequence (MTP Porgrammed)

| ITEM                          | "I" NDEX<br>or<br>"D" ATA | HEX | REMARK |
|-------------------------------|---------------------------|-----|--------|
| VDD=2.85[V]                   |                           |     |        |
| WAIT 1ms                      |                           |     |        |
| VDDIO=1.8[V]                  |                           |     |        |
| WAIT 1ms                      |                           |     |        |
| XRES=L⇒H                      |                           |     |        |
| WAIT 5ms                      |                           |     |        |
| VSP=5.6[V]                    |                           |     |        |
| WAIT 1ms                      |                           |     |        |
| VSN=-5.4[V]                   |                           |     |        |
| WAIT 1ms                      |                           |     |        |
| DSI Video mode transfer start |                           |     |        |
| WAIT 2V                       |                           |     |        |
| Sleep Out                     | Command                   | 11h |        |
| WAIT 120ms                    |                           |     |        |
|                               | Command                   | DFh |        |
|                               | 1st parameter             | 55h |        |
|                               | 2nd parameter             | AAh |        |
|                               | 3rd parameter             | 52h |        |
|                               | 4th parameter             | 08h |        |
|                               | 5th parameter             | 10h |        |
|                               | Command                   | F1h |        |
|                               | Parameter                 | 08h |        |
|                               | Command                   | F7h |        |
|                               | 1st parameter             | 25h |        |
|                               | 2nd parameter             | 00h |        |
|                               | 3rd parameter             | 3Dh |        |
| Display On                    | Command                   | 29h |        |

## 2) POWER OFF

| ITEM                        | "I"NDEx<br>or<br>"D"ATA | HEX | REMARK |
|-----------------------------|-------------------------|-----|--------|
| Display Off                 | Command                 | 28h |        |
| SLEEP IN                    | Command                 | 10h |        |
| Wait 3V                     |                         |     |        |
| DSI Video mode transfer end |                         |     |        |
| WAIT 120ms                  |                         |     |        |
| VSN OFF                     |                         |     |        |
| WAIT 1ms                    |                         |     |        |
| VSP OFF                     |                         |     |        |
| WAIT 1ms                    |                         |     |        |
| XRES=H⇒L                    |                         |     |        |
| WAIT 1ms                    |                         |     |        |
| VDDIO OFF                   |                         |     |        |
| WAIT 1ms                    |                         |     |        |
| VDD OFF                     |                         |     |        |

## 3) CABC On

|                          |               |     |                  |
|--------------------------|---------------|-----|------------------|
| Write Display Brightness | Command       | 51h |                  |
|                          | 1st parameter | FFh |                  |
| Write CTRL Display       | Command       | 53h |                  |
|                          | 1st parameter | 24h |                  |
| CABC On                  | Command       | 55h |                  |
|                          | 1st parameter | 02h | Still Image Mode |

## 6 Optical Characteristics

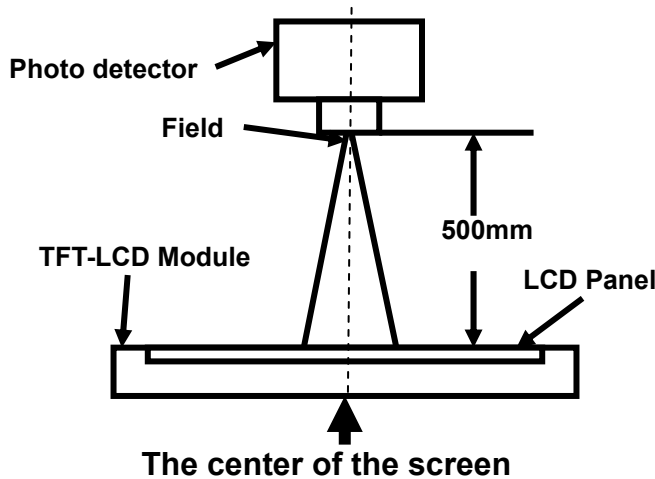
| Item           |       | Symbol           | Condition       | Min  | Typ  | Max  | Unit              | Remark   |
|----------------|-------|------------------|-----------------|------|------|------|-------------------|----------|
| View Angles    |       | θT               | CR≧10           | -    | 85   | -    | Degree            | Note2,3  |
|                |       | θB               |                 | -    | 85   | -    |                   |          |
|                |       | θL               |                 | -    | 85   | -    |                   |          |
|                |       | θR               |                 | -    | 85   | -    |                   |          |
| Contrast Ratio |       | CR               | θ=0°            | -    | 900  | -    |                   | Note 3   |
| Response Time  |       | T <sub>ON</sub>  | 25℃             | -    | 35   | -    | ms                | Note 4   |
|                |       | T <sub>OFF</sub> |                 |      |      |      |                   |          |
| Chromaticity   | White | x                | Backlight is on | 0.26 | 0.31 | 0.36 |                   | Note 1,5 |
|                |       | y                |                 | 0.28 | 0.33 | 0.38 |                   |          |
|                | Red   | x                |                 |      |      |      |                   | Note 1,5 |
|                |       | y                |                 |      |      |      |                   |          |
|                | Green | x                |                 |      |      |      |                   | Note 1,5 |
|                |       | y                |                 |      |      |      |                   |          |
|                | Blue  | x                |                 |      |      |      |                   | Note 1,5 |
|                |       | y                |                 |      |      |      |                   |          |
| Uniformity     |       | U                |                 | 75   | 80   | --   | %                 | Note 6   |
| Luminance      |       | L                |                 | 450  | 500  | -    | cd/m <sup>2</sup> | Note 7   |

Test Conditions:

1.  $I_F = 20$  mA, and the ambient temperature is 25℃.
2. The test systems refer to Note 1 and Note 2.

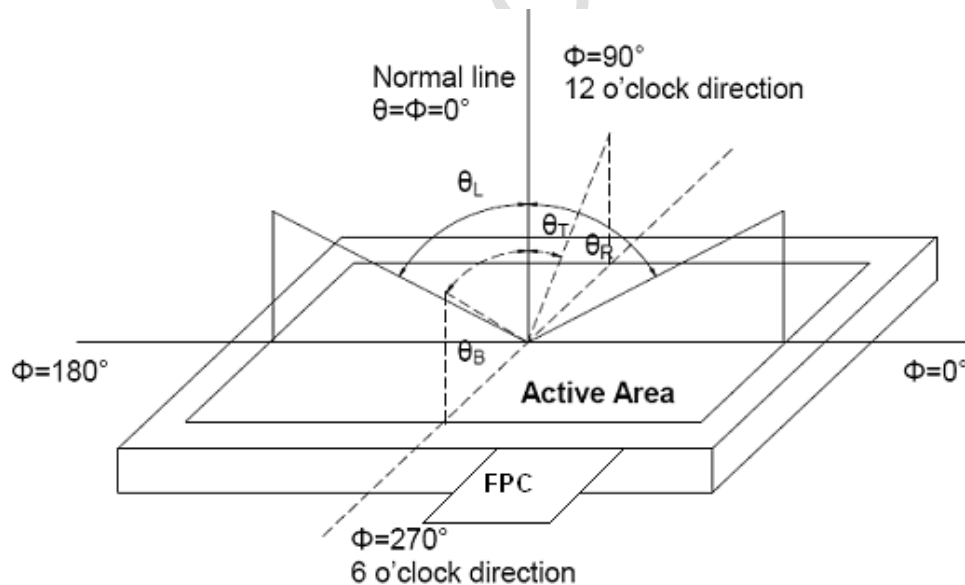
Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD.



Note 3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

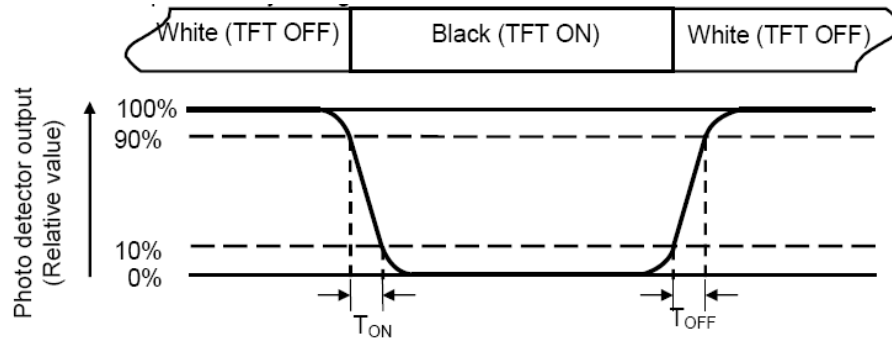
"White state ": The state is that the LCD should drive by  $V_{\text{white}}$ .

"Black state": The state is that the LCD should drive by  $V_{\text{black}}$ .

$V_{\text{white}}$ : To be determined       $V_{\text{black}}$ : To be determined.

**Note 4: Definition of Response time**

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time ( $T_{ON}$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_{OFF}$ ) is the time between photo detector output intensity changed from 10% to 90%.



**Note 5: Definition of color chromaticity (CIE1931)**

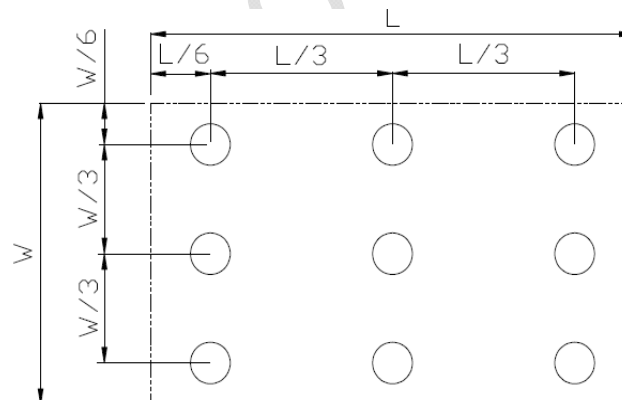
Color coordinates measured at center point of LCD.

**Note 6: Definition of Luminance Uniformity**

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (U)} = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width



$L_{\max}$ : The measured Maximum luminance of all measurement position.

$L_{\min}$ : The measured Minimum luminance of all measurement position.

**Note 7: Definition of Luminance:**

Measure the luminance of white state at center point.

## 7 Environmental / Reliability Test

| No | Test Item                                | Condition                                                                                                    | Remarks                                                                                             |
|----|------------------------------------------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| 1  | High Temperature Operation               | 60℃, 120Hours                                                                                                | IEC60068-2-1:2007<br>GB2423.2-2008                                                                  |
| 2  | Low Temperature Operation                | -20℃, 120Hours                                                                                               | IEC60068-2-1:2007<br>GB2423.1-2008                                                                  |
| 3  | High Temperature Storage                 | 70℃, 120Hours                                                                                                | IEC60068-2-1:2007<br>GB2423.2-2008                                                                  |
| 4  | Low Temperature Storage                  | -30℃, 120Hours                                                                                               | IEC60068-2-1:2007<br>GB2423.1-2008                                                                  |
| 5  | Storage at High Temperature and Humidity | 60℃, 90%RH, 120Hours                                                                                         | IEC60068-2-78 :2001<br>GB/T2423.3—2006                                                              |
| 6  | Thermal Shock (non-operation)            | -20℃ ↔ 70℃, ON/OFF, 20CYC                                                                                    | Start with cold temperature,<br>End with high temperature,<br>IEC60068-2-14:1984,G<br>B2423.22-2002 |
| 7  | ESD                                      | Voltage:±8KV<br>R:330 ohm,C:150pF<br>Air discharge,10 times                                                  | IEC61000-4-2:2001<br>GB/T17626.2-2006                                                               |
| 8  | Vibration Test                           | 10 => 55 =>10 => 55 => 10 Hz,<br>within 1 minute;Amplitude:1.5mm.<br>15 minutes for each Direction ( X,Y,Z ) | IEC60068-2-6:1982<br>GB/T2423.10—1995                                                               |
| 10 | Package Drop Test                        | Packed, 66CM free fall<br>6 sides, 1 corner, 3edges                                                          | IEC60068-2-32:1990<br>GB/T2423.8—1995                                                               |

Note1: Ts is the temperature of panel's surface.

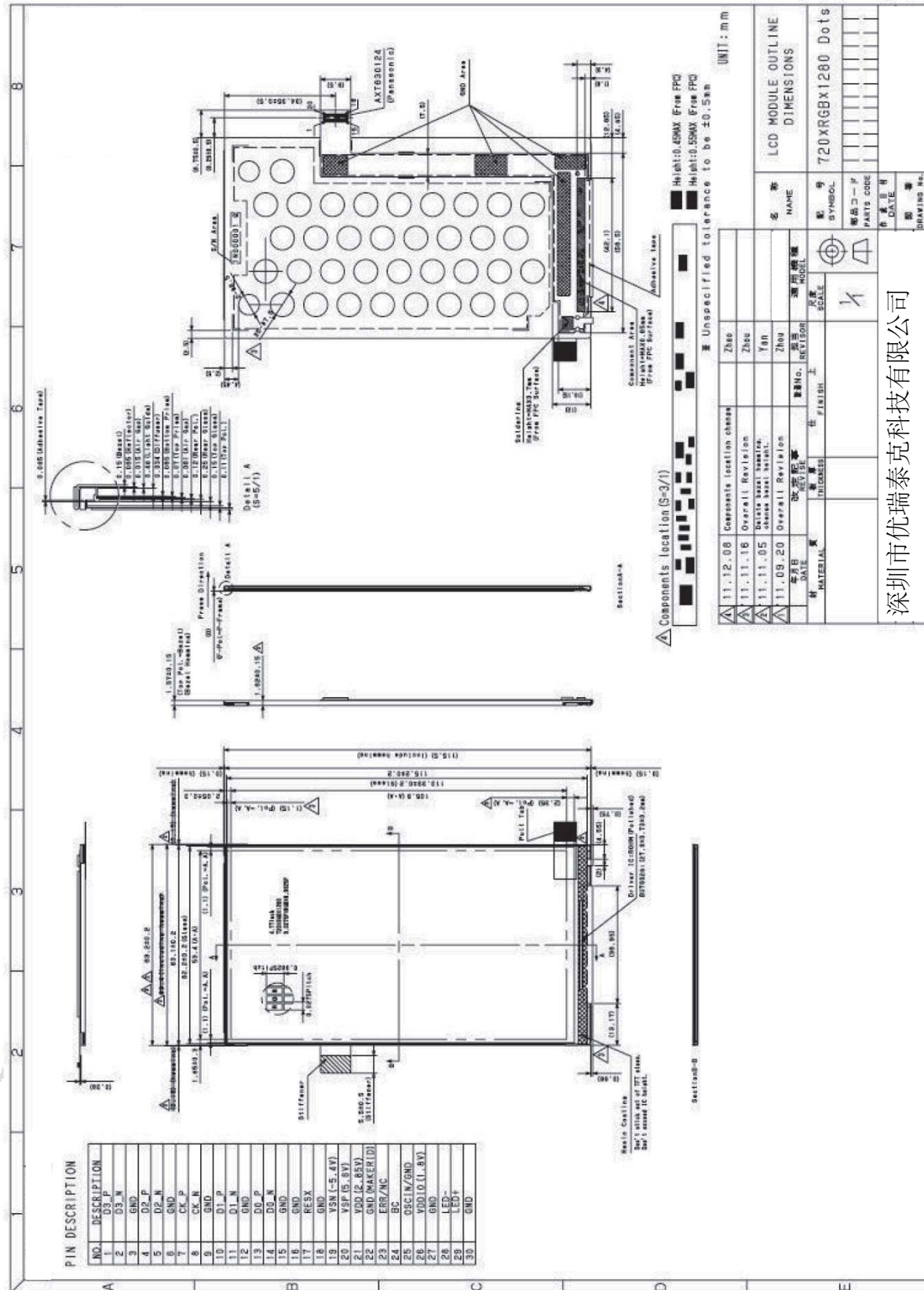
Note2: Ta is the ambient temperature of sample.

Note3: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note 4: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.



## 8. Outline Dimension



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## 9 Packing Drawing

TBD

## 10 Precautions for Use of LCD Modules

### a) Handling Precautions

- i. The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- ii. If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- iii. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- iv. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- v. If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
  - Isopropyl alcohol
  - Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
  - Ketone
  - Aromatic solvents
- vi. Do not attempt to disassemble the LCD Module.
  - vii. If the logic circuit power is off, do not apply the input signals.
  - viii. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

10.1.8.1 Be sure to ground the body when handling the LCD Modules.

10.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

10.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

10.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

### b) Storage precautions

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i. When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

ii. The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ~ 40℃ Relatively humidity: ≤80%

iii. The LCD modules should be stored in the room without acid, alkali and harmful gas.

c) Transportation Precautions

i. The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.