

# INDUSTRIAL STRENGTH... Start Your Application From YOURITECH





## CUSTOMER APPROVAL SHEET

|                              |             |
|------------------------------|-------------|
| <b>Company Name</b>          |             |
| <b>MODEL</b>                 | C203RAT01.0 |
| <b>CUSTOMER<br/>APPROVED</b> |             |

- ☐ APPROVAL FOR SPECIFICATIONS ONLY (Spec. Ver. 1.0)
- ☐ APPROVAL FOR SPECIFICATIONS AND ES SAMPLE (Spec. Ver. 1.0)
- ☐ APPROVAL FOR SPECIFICATIONS AND CS SAMPLE (Spec. Ver. 1.0)
- ☐ CUSTOMER REMARK :

1 Li-Hsin Rd. 2. Science-Based Industrial Park  
Hsinchu 300, Taiwan, R.O.C.  
Tel: +886-3-500-8899  
Fax: +886-3-577-2730



|              |            |
|--------------|------------|
| Doc. Version | 1.0        |
| Total Page   | 35         |
| Date         | 2019/08/02 |

# Product Specification

## 20.3" COLOR TFT-LCD MODULE

**MODEL NAME: C203RAT01.0**

**Model Name: C203RAT01.0**

---

**Planned Lifetime:** From 2020/June.

---

**Phase-out Control:**

---

**EOL Schedule:**

---

< > Preliminary Specification

< ◆ > Final Specification

Note: The content of this specification is subject to change.

© 2018 AU Optronics  
All Rights Reserved,  
Do Not Copy.

## Record of Revision

| Version | Revise Date | Page | Content                                            |
|---------|-------------|------|----------------------------------------------------|
| 0.0     | 2018/11/11  |      | First draft.(Touch spec.)                          |
| 0.1     | 2018/12/12  | 8    | Module Outline Dimension                           |
|         |             | 18   | Backlight Driving Conditions and De-rating profile |
| 0.2     | 2019/02/25  | 10   | Electrical Specifications                          |
| 0.3     | 2019/05/10  | 9    | Module Outline Dimension                           |
| 0.4     | 2019/08/02  | 8    | Lens specification                                 |
| 0.5     | 2020/02/26  | 9    | Module Outline Dimension                           |
|         |             | 30   | RA heat shock condition and ESD specification      |
| 0.6     | 2020/03/11  | 8    | cover-lens spec.                                   |
| 0.7     | 2020/04/22  | 30   | IS spec.                                           |
| 0.8     | 2020/05/08  | 9    | Module Outline Dimension                           |
| 0.9     | 2020/05/21  | 26   | Repower ON / OFF                                   |
|         |             | 31   | Modify IS spec.                                    |
|         |             | 20   | Update the typ. value of LED Supply Voltage        |
| 1.0     | 2020/07/21  | 9    | Module Outline Dimension                           |
|         |             |      |                                                    |
|         |             |      |                                                    |
|         |             |      |                                                    |
|         |             |      |                                                    |
|         |             |      |                                                    |
|         |             |      |                                                    |

# Contents

|           |                                                                                      |                    |
|-----------|--------------------------------------------------------------------------------------|--------------------|
| <b>A.</b> | <b>General Description .....</b>                                                     | <b>6</b>           |
| <b>B.</b> | <b>Features .....</b>                                                                | <b>6</b>           |
| <b>C.</b> | <b>Physical Specifications .....</b>                                                 | <b>7</b>           |
|           | <b>1. TFT LCD Panel.....</b>                                                         | <b>7</b>           |
|           | <b>2. Capacitive Touch Panel .....</b>                                               | <b>8</b>           |
|           | <b>3. Lens specification .....</b>                                                   | <b>8</b>           |
| <b>D.</b> | <b>Outline Dimension.....</b>                                                        | <b>9</b>           |
|           | <b>1. TFT-LCD Module.....</b>                                                        | <b>9</b>           |
| <b>E.</b> | <b>Electrical Specifications .....</b>                                               | <b>10</b>          |
|           | <b>1. TFT LCD Panel Pin Assignment .....</b>                                         | <b>10</b>          |
|           | a. TFT LCD Pin Assignment.....                                                       | 10                 |
|           | b. Touch Sensor Pin Assignment .....                                                 | 12                 |
|           | <b>2. Differential Input Data Format .....</b>                                       | <b>14</b>          |
|           | a. Signal DC Electrical Characteristics.....                                         | 14                 |
|           | <b>3. AC Electrical Characteristics .....</b>                                        | <b>15</b>          |
|           | a. Differential signal AC characteristics.....                                       | 15                 |
|           | <b>4. Fig. 7 Data skew margin Differential Input Data Format .....</b>               | <b>16</b>          |
|           | <b>5. Input Timing Diagram .....</b>                                                 | <b>17</b>          |
|           | <b>6. Absolute Maximum Ratings .....</b>                                             | <b>18</b>          |
|           | <b>7. DC Electrical Characteristics .....</b>                                        | <b>18</b>          |
|           | a. Power Specification.....                                                          | 18                 |
|           | b. Touch Panel Driving Condition .....                                               | 19                 |
|           | c. Backlight Driving Conditions (Note 1) .....                                       | 20                 |
|           | <b>8. AC Electrical Characteristics .....</b>                                        | <b>21</b>          |
|           | a. Input AC characteristics .....                                                    | 21                 |
|           | <b>9. I2C Specification .....</b>                                                    | <b>22</b>          |
|           | <b>10. Chip-Level AC Specification .....</b>                                         | <b>23</b>          |
|           | <b>11. Power on/off sequence .....</b>                                               | <b>25</b>          |
|           | a. Power on: .....                                                                   | 25                 |
|           | b. Power off: .....                                                                  | 26                 |
|           | c. Repower ON / OFF (other signal need to follow normal power on/off sequence) ..... | 26                 |
| <b>F.</b> | <b>Optical specifications (all for reference).....</b>                               | <b>27</b>          |
| <b>G.</b> | <b>Reliability Test Items(Note 1~3) .....</b>                                        | <b>30</b>          |
| <b>H.</b> | <b>Packing and Marking.....</b>                                                      | <b>錯誤! 尚未定義書籤。</b> |
|           | <b>1. Packing Form.....</b>                                                          | <b>錯誤! 尚未定義書籤。</b> |

|                                               |           |
|-----------------------------------------------|-----------|
| <b>2. Module/Panel Label Information.....</b> | <b>33</b> |
| <b>3. Carton Label Information .....</b>      | <b>33</b> |
| <b>4. Warehouse storage condition:.....</b>   | <b>34</b> |

## A. General Description

C203RA01.0 is an a-Si type Thin Film Transistor Liquid crystal Display (TFT-LCD) with AHVA (Advanced Hyper-Viewing Angle) technology. This model is composed of a TFT-LCD, driver ICs, FPCA, backlight unit and a capacitive touch sensor glass.

## B. Features

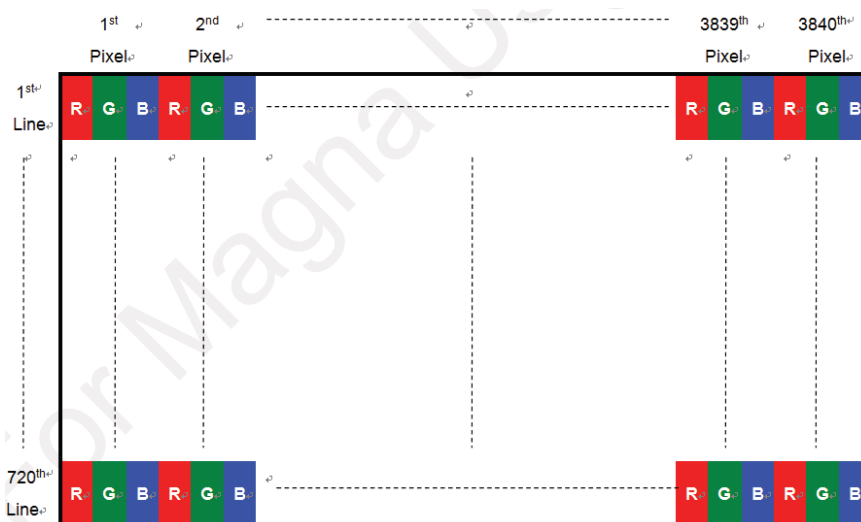
- 20.3"-inch display
- 3840 RGB x 720 resolution in RGB stripe dot arrangement
- Interfaces: LVDS
- AHVA – wide view technology
- RoHs compliance
- Touch sensor glass
- Cover lens

## C. Physical Specifications

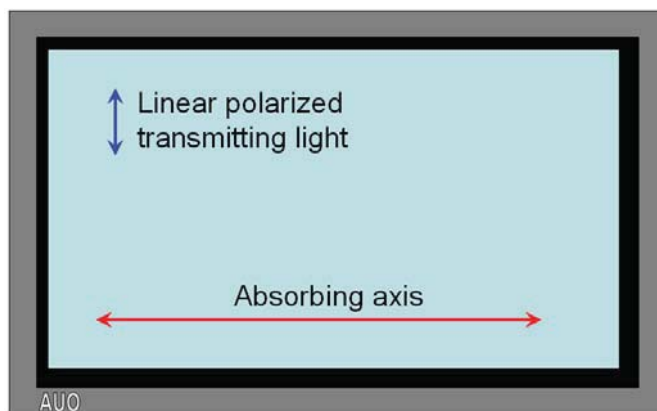
### 1. TFT LCD Panel

| NO. | Item                | Unit          | Specification           | Remark |
|-----|---------------------|---------------|-------------------------|--------|
| 1   | Display Resolution  | dot           | 3840 RGB(H)x 720(V)     |        |
| 2   | Active Area         | mm            | 506.88 x 95.04 mm       |        |
| 3   | Screen Size         | inch          | 20.3"(Diagonal)         |        |
| 4   | Dot Pitch           | $\mu\text{m}$ | 132 $\mu\text{m}$       |        |
| 5   | Color Configuration | —             | R. G. B. Stripe         |        |
| 6   | Color Depth         | —             | 16.7 M colors           |        |
| 7   | Overall Dimension   | mm            | 555.01 * 126.98 * 30.31 |        |
| 8   | Weight              | g             | 1190g +/-10%            |        |
| 9   | Display Mode        | -             | Normal Black            |        |

Note 1: Below figure shows dot stripe arrangement.



Note 2: Below figure shows dot stripe arrangement.



## 2. Capacitive Touch Panel

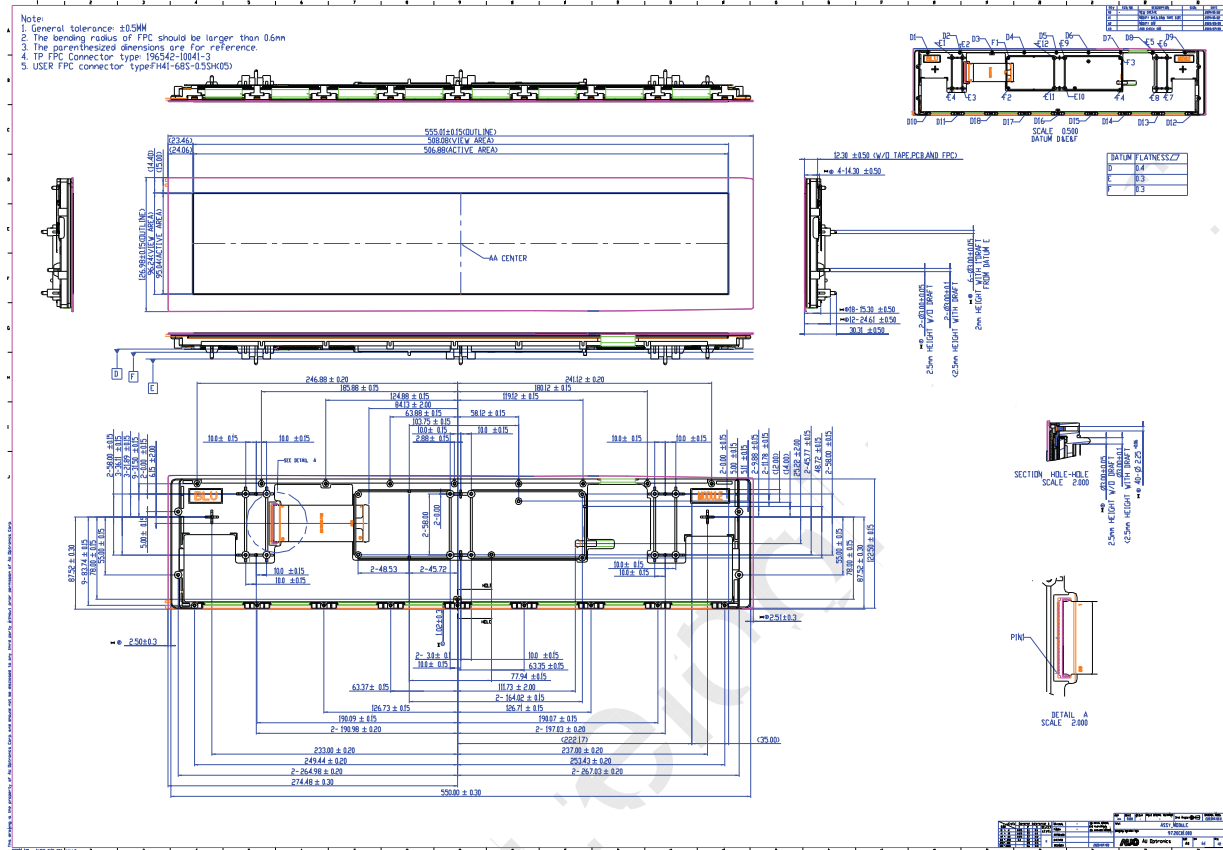
| NO. | Item                   | Unit | Specification                               | Remark                               |
|-----|------------------------|------|---------------------------------------------|--------------------------------------|
| 1   | Touch Panel Controller | -    | CYAT817AZS98-5BFBA                          |                                      |
| 2   | Touch Channel (AA)     | -    | RX82*TX16                                   | (RX0~RX81 , TX0~TX15)                |
| 3   | Sensing Mode           | -    | Self and Mutual both                        |                                      |
| 4   | Interface              | -    | I2C                                         |                                      |
| 5   | Linearity              | mm   | $< \pm 1\text{mm} @ \Phi 8\text{mm}$ copper |                                      |
| 6   | Accuracy               | mm   | $< \pm 1\text{mm} @ \Phi 8\text{mm}$ copper |                                      |
| 7   | Finger separation      | mm   | $< 13\text{mm} @ 8\text{mm}$ copper         |                                      |
| 8   | Multi touch Support    |      | 10-point                                    |                                      |
| 9   | Response time          | Ms   | $< 30\text{ ms}$                            |                                      |
| 10  | Thick Glove support    | Mm   | $\leq 2\text{ mm}$                          | finger to cover                      |
| 11  | Actuation Force        | N    | 0.1N~0.3N                                   |                                      |
| 12  | Finger Touch Range     | mm   | $\geq 8\text{mm}$                           | Minimum diameter of finger supported |

## 3. Lens specification

| NO. | Item                     | Unit | Specification                  | Remark          |
|-----|--------------------------|------|--------------------------------|-----------------|
| 1   | Glass Material           | --   | Corning Gorilla For Automotive | Cover lens only |
| 2   | Thickness                | mm   | 1.3 mm                         | Cover lens only |
| 3   | Surface treatment        | --   | ARAF                           | Cover lens only |
| 4   | Transmission of window   | %    | $> 94\% @ 550\text{nm}$        | Cover lens only |
| 5   | Depth of Layer(DOL)      | um   | $> 45\text{um}$                | Cover lens only |
| 6   | Compressive Sress (CS)   | Mpa  | $> 775\text{Mpa}$              | Cover lens only |
| 7   | Surface Hardness         |      | $> 7\text{H}$                  | Cover lens only |
| 8   | AF (Water contact angle) | deg  | $> 110\text{deg}$              | Cover lens only |

## D. Outline Dimension

### 1. TFT-LCD Module



## E. Electrical Specifications

### 1. TFT LCD Panel Pin Assignment

#### a. TFT LCD Pin Assignment

Recommended Connector: HIROSE FH41-68S-0.5SH

| No. | Pin Name | I/O | Description                                                                         | Remarks |
|-----|----------|-----|-------------------------------------------------------------------------------------|---------|
| 1   | GND      | G   | Ground                                                                              |         |
| 2   | TH-      | O   | Thermistor Negative Pin                                                             |         |
| 3   | TH+      | O   | Thermistor Positive Pin                                                             |         |
| 4   | NC       | N   | AUO Not Connect                                                                     |         |
| 5   | LED-6    | P   | Power of LED(-)                                                                     |         |
| 6   | LED-5    | P   | Power of LED(-)                                                                     |         |
| 7   | LED-4    | P   | Power of LED(-)                                                                     |         |
| 8   | LED-3    | P   | Power of LED(-)                                                                     |         |
| 9   | LED-2    | P   | Power of LED(-)                                                                     |         |
| 10  | LED-1    | P   | Power of LED(-)                                                                     |         |
| 11  | NC       | N   | AUO Not Connect                                                                     |         |
| 12  | LED+     | P   | Power of LED(+)                                                                     |         |
| 13  | LED+     | P   | Power of LED(+)                                                                     |         |
| 14  | LED+     | P   | Power of LED(+)                                                                     |         |
| 15  | LED+     | P   | Power of LED(+)                                                                     |         |
| 16  | NC       | N   | AUO Not Connect                                                                     |         |
| 17  | FAIL_DET | O   | Tcon Safety Function (Abnormal Signal Detection)<br>(Normal : H / Abnormal : L)     |         |
| 18  | Reset    | I   | Tcon Hardwave Reset Pin (Default Setting : H)                                       |         |
| 19  | Power_EN | I   | PWM IC Enable Pin, internal pull high with 10Kohm resistor (Enable: H / Disable: L) |         |
| 20  | UDLR     | I   | Scan Direction Pin (Default Setting : L )                                           | Note 1  |
| 21  | GND      | G   | Ground                                                                              |         |
| 22  | SCL      | I   | Serial Clock Input For I2C I/F                                                      |         |
| 23  | SDA      | I/O | Serial Clock Input For I2C I/F                                                      |         |
| 24  | GND      | G   | Ground                                                                              |         |
| 25  | RXOIN0-  | I   | Negative LVDS differential data input. (Odd data)                                   |         |
| 26  | RXOIN0+  | I   | Positive LVDS differential data input. (Odd data)                                   |         |
| 27  | GND      | G   | Ground                                                                              |         |
| 28  | RXOIN1-  | I   | Negative LVDS differential data input. (Odd data)                                   |         |
| 29  | RXOIN1+  | I   | Positive LVDS differential data input. (Odd data)                                   |         |
| 30  | GND      | G   | Ground                                                                              |         |
| 31  | RXOIN2-  | I   | Negative LVDS differential data input. (Odd data)                                   |         |
| 32  | RXOIN2+  | I   | Positive LVDS differential data input. (Odd data)                                   |         |

|    |         |   |                                                      |  |
|----|---------|---|------------------------------------------------------|--|
| 33 | GND     | G | Ground                                               |  |
| 34 | RXOCLK- | I | Negative LVDS differential clock input. (Odd Clock)  |  |
| 35 | RXOCLK+ | I | Positive LVDS differential clock input. (Odd Clock)  |  |
| 36 | GND     | G | Ground                                               |  |
| 37 | RXOIN3- | I | Negative LVDS differential data input. (Odd data)    |  |
| 38 | RXOIN3+ | I | Positive LVDS differential data input. (Odd data)    |  |
| 39 | GND     | G | Ground                                               |  |
| 40 | RXEIN0- | I | Negative LVDS differential data input. (Even data)   |  |
| 41 | RXEIN0+ | I | Positive LVDS differential data input. (Even data)   |  |
| 42 | GND     | G | Ground                                               |  |
| 43 | RXEIN1- | I | Negative LVDS differential data input. (Even data)   |  |
| 44 | RXEIN1+ | I | Positive LVDS differential data input. (Even data)   |  |
| 45 | GND     | G | Ground                                               |  |
| 46 | RXEIN2- | I | Negative LVDS differential data input. (Even data)   |  |
| 47 | RXEIN2+ | I | Positive LVDS differential data input. (Even data)   |  |
| 48 | GND     | G | Ground                                               |  |
| 49 | RXECLK- | I | Negative LVDS differential clock input. (Even Clock) |  |
| 50 | RXECLK+ | I | Positive LVDS differential clock input. (Even Clock) |  |
| 51 | GND     | G | Ground                                               |  |
| 52 | RXEIN3- | I | Negative LVDS differential data input. (Even data)   |  |
| 53 | RXEIN3+ | I | Positive LVDS differential data input. (Even data)   |  |
| 54 | GND     | G | Ground                                               |  |
| 55 | GND     | G | Ground                                               |  |
| 56 | GND     | G | Ground                                               |  |
| 57 | NC      | N | AUO Not Connect                                      |  |
| 58 | VDD     | P | Power Supply Input Voltage (3.3V)                    |  |
| 59 | VDD     | P | Power Supply Input Voltage (3.3V)                    |  |
| 60 | VDD     | P | Power Supply Input Voltage (3.3V)                    |  |
| 61 | VDD     | P | Power Supply Input Voltage (3.3V)                    |  |
| 62 | VDD     | P | Power Supply Input Voltage (3.3V)                    |  |
| 63 | VDD     | P | Power Supply Input Voltage (3.3V)                    |  |
| 64 | NC      | N | AUO Not Connect                                      |  |
| 65 | GND     | G | Ground                                               |  |
| 66 | GND     | G | Ground                                               |  |
| 67 | TP_SYNC | O | For TP used (TP_SYNC output once per each line )     |  |
| 68 | GND     | G | Ground                                               |  |

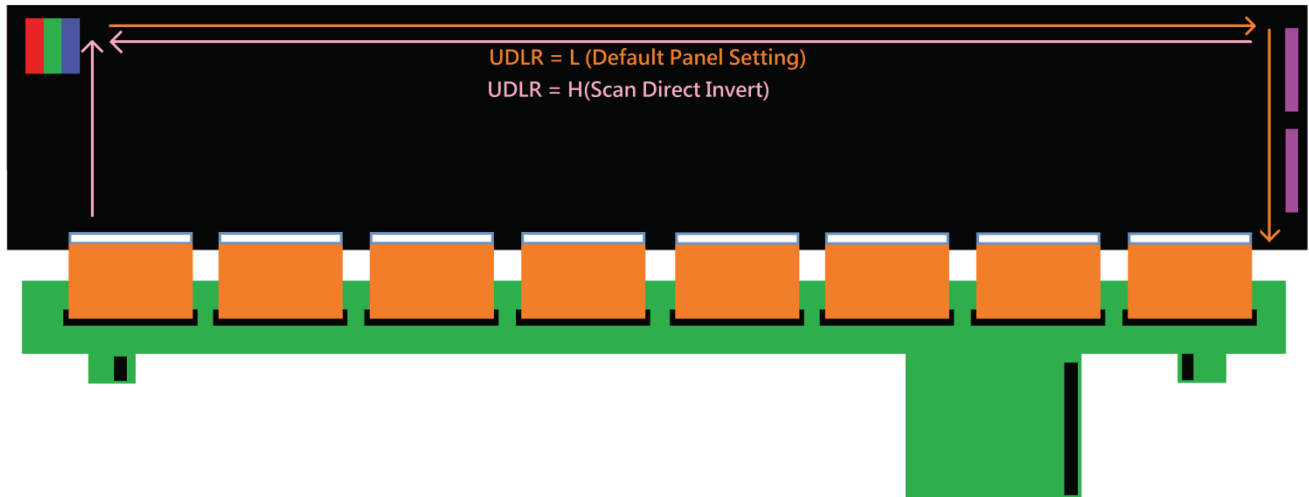
**I: Digital signal input, O: Digital signal output, G: GND, P: Power input**

ALL RIGHTS STRICTLY RESERVED. ANY PORTION OF THIS PAPER SHALL NOT BE REPRODUCED, COPIED, OR TRANSFORMED TO ANY OTHER FORMS WITHOUT PERMISSION FROM AU OPTRONICS CORP.

Note 1 :

UDLR = "L": Normal Scanning Mode (left-to-right and up-down) – Internal Default Setting

UDLR = "H": Invert Scanning Mode (right-to-left and down-to-up)

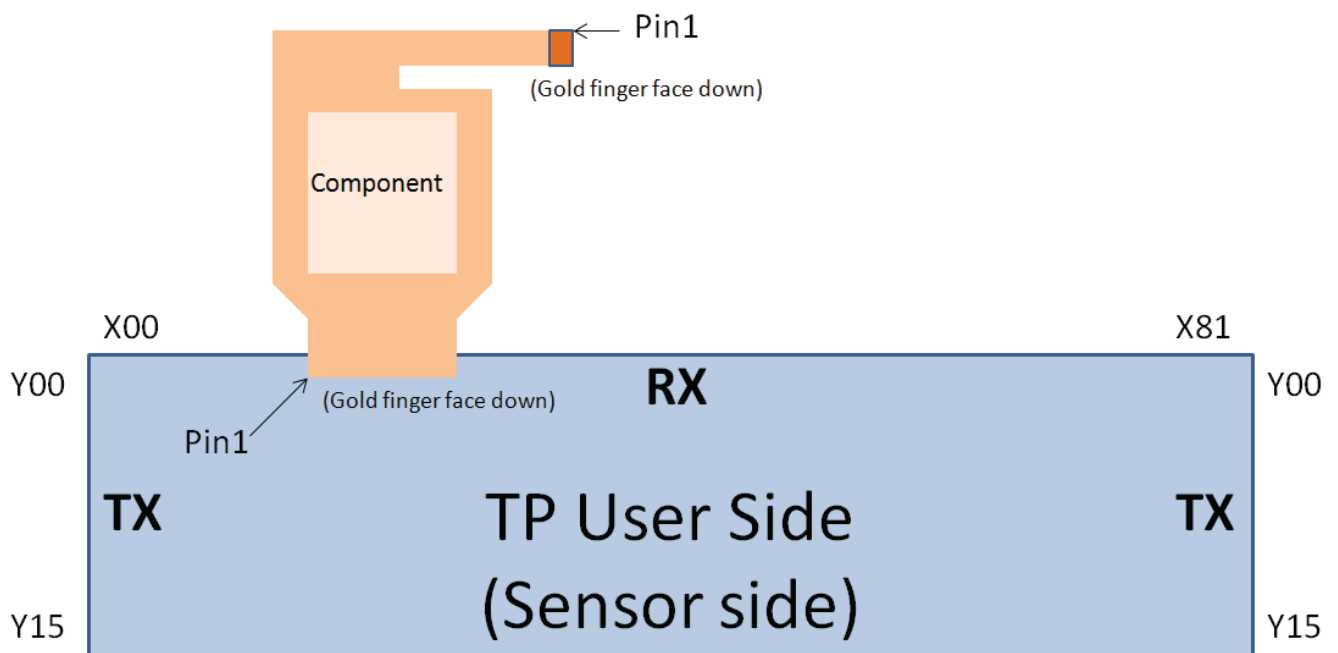


## b. Touch Sensor Pin Assignment

Connector=P-TWO, 196542-10041-3

| Pin No. | Symbol    | I/O | Description                              | Remark |
|---------|-----------|-----|------------------------------------------|--------|
| 1       | GND       | G   | Ground                                   |        |
| 2       | VDDD      | P   | Power input                              |        |
| 3       | SWDCLK    | I   | SWDCLK                                   |        |
| 4       | SWDIO     | I/O | SWDIO                                    |        |
| 5       | INT       | O   | COMM_INT                                 |        |
| 6       | EXT_START | I   | External start signal LCD display H-sync |        |
| 7       | I2C_SDA   | I/O | I2C SDA                                  |        |
| 8       | I2C_SCL   | I   | I2C SCL                                  |        |
| 9       | XRES      | I   | Reset                                    |        |
| 10      | GND       | G   | Ground                                   |        |

I : input signal , O : output signal , I/O : input/output signal , G: GND , P: power input

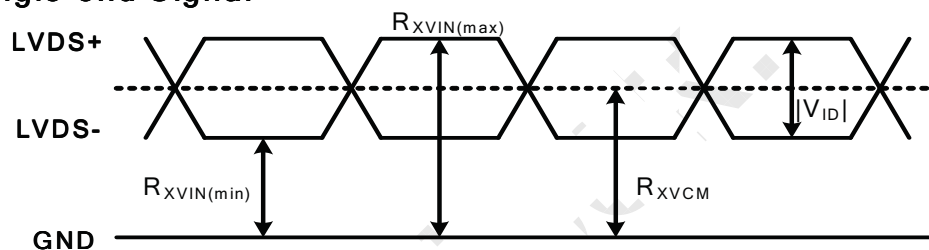


## 2. Differential Input Data Format

### a. Signal DC Electrical Characteristics

| Parameter                              | Symbol     | Min  | Typ | Max | Unit | Notes           |
|----------------------------------------|------------|------|-----|-----|------|-----------------|
| Differential input high threshold      | $R_{XVTH}$ | -    | -   | 200 | mV   | $R_{XVCM}=1.2V$ |
| Differential input low threshold       | $R_{XVTL}$ | -200 | -   | -   | mV   | $R_{XVCM}=1.2V$ |
| Input voltage range (singled-end)      | $R_{XVIN}$ | 0.7  | -   | 1.7 | V    |                 |
| Input differential voltage             | $ V_{ID} $ | 200  | -   | 600 | mV   |                 |
| Differential Input Common Mode Voltage | $R_{XVCM}$ | 1.0  | 1.2 | 1.4 | V    |                 |

#### Single-end Signal



#### Differential Signal

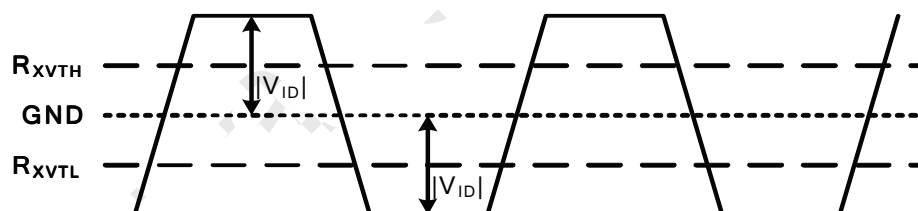


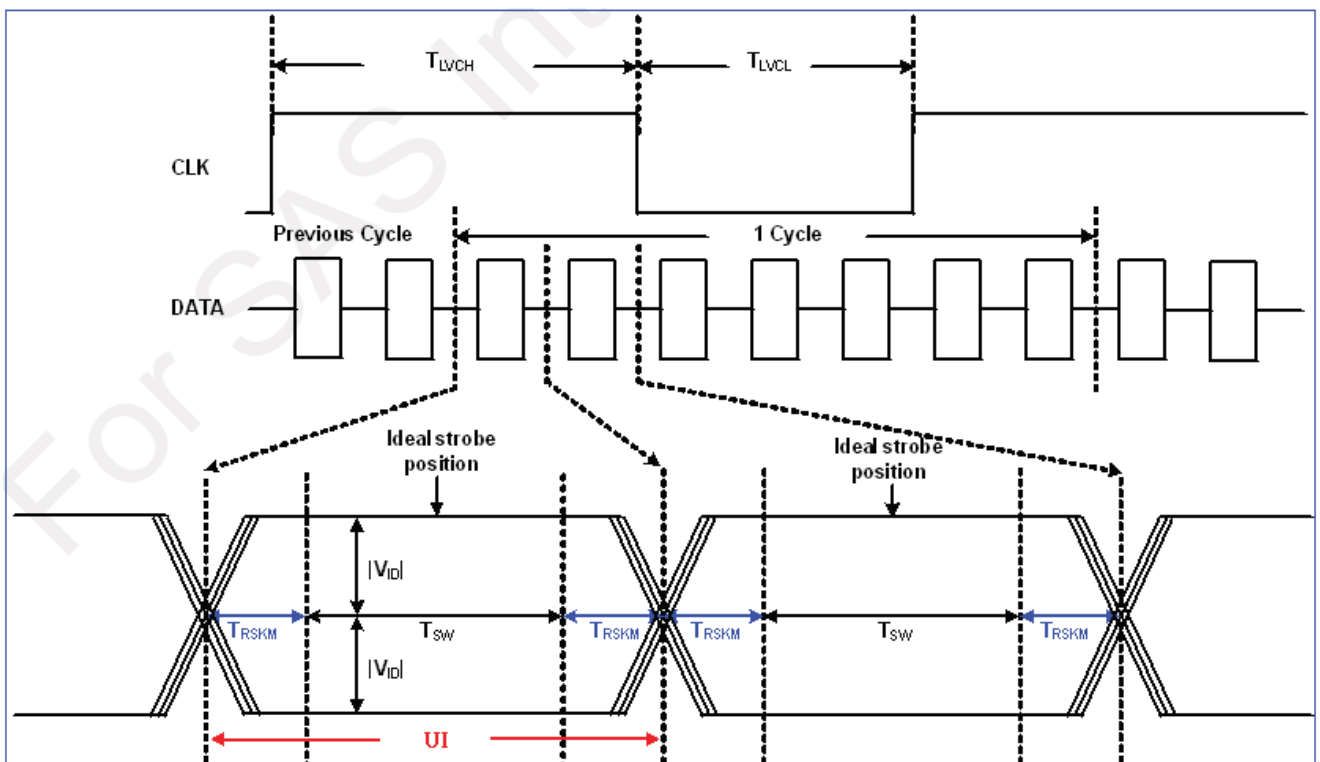
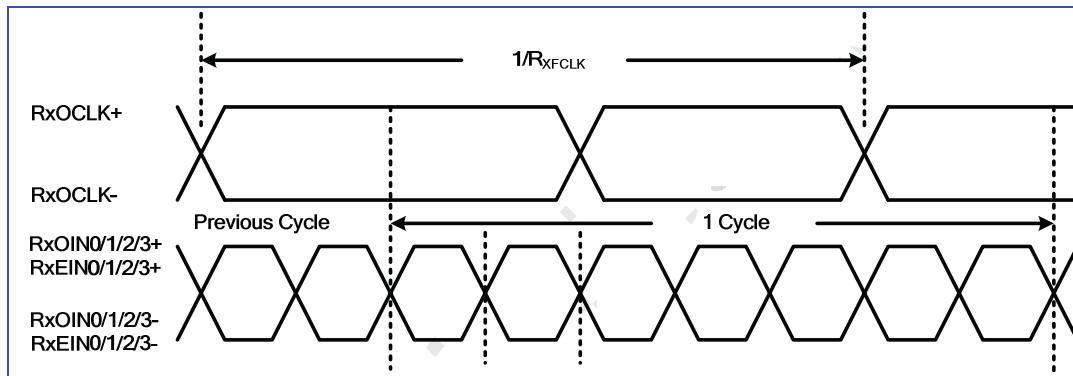
Fig. 1 LVDS DC characteristics diagram

### 3. AC Electrical Characteristics

#### a. Differential signal AC characteristics

| Parameter              | Symbol      | Min.  | Typ.                | Max.  | Unit | Remark                                    |
|------------------------|-------------|-------|---------------------|-------|------|-------------------------------------------|
| Clock frequency        | $R_{XFCLK}$ | 87.76 | 88.92               | 92.25 | MHz  |                                           |
| Input data skew margin | $T_{RSKM}$  | -     | -                   | 1/4   | UI   | $ VID =200mV$<br>$R_{XVCM}=1.2V$<br>Note1 |
| Clock strobe width     | $T_{SW}$    | 1/2   | -                   | -     | UI   |                                           |
| Clock High Time        | $T_{LVCH}$  | -     | $4/(7 * R_{XFCLK})$ | -     | ns   |                                           |
| Clock Low Time         | $T_{LVCL}$  | -     | $3/(7 * R_{XFCLK})$ | -     | ns   |                                           |

Note1. For the Data Skew Margin, "Input Signal Skew + Input Signal Jitter" must be smaller than  $T_{RSKM}$ .



#### 4. Fig. 7 Data skew margin Differential Input Data Format

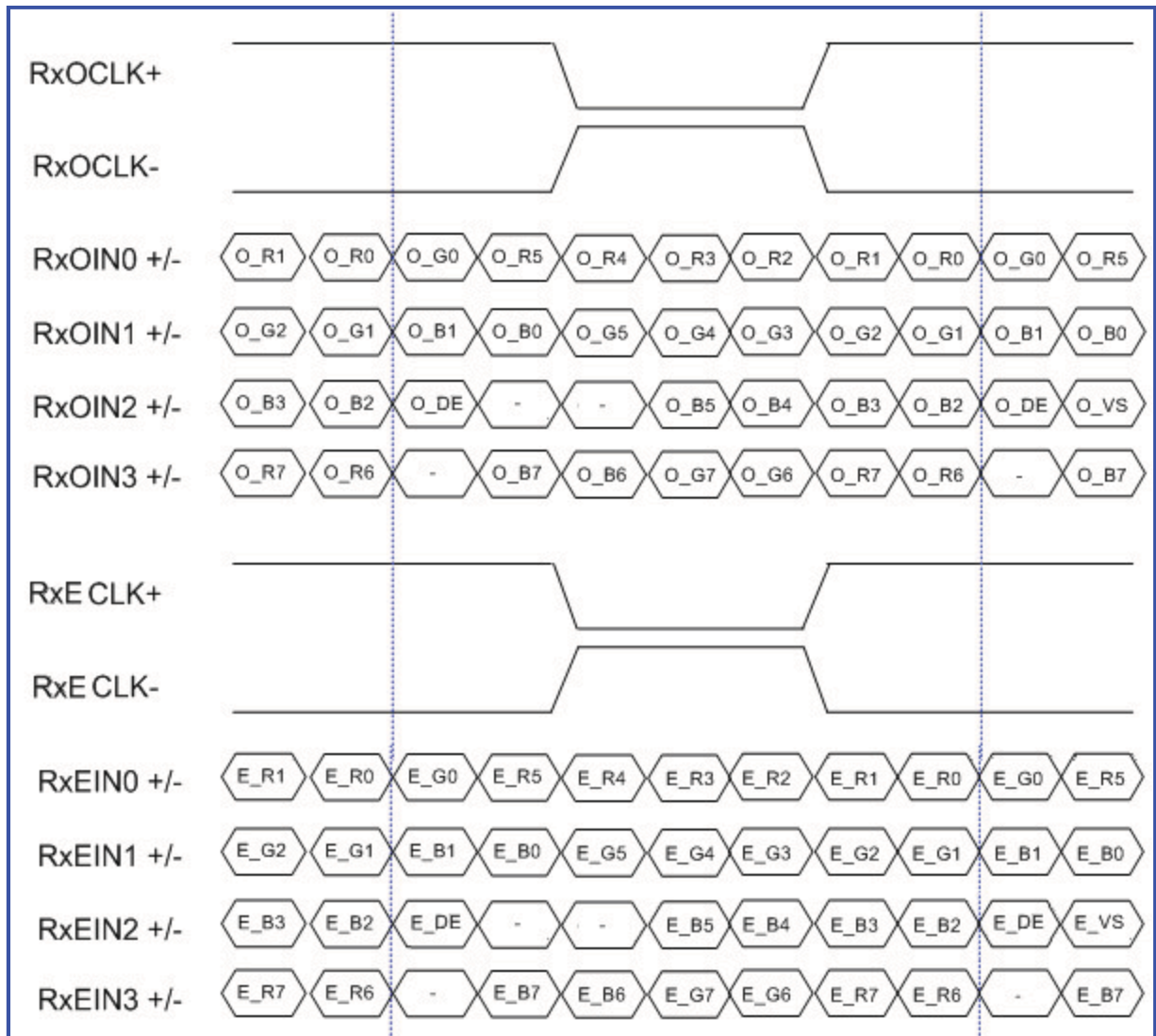


Fig.2 LVDS input data VESA format

## 5. Input Timing Diagram

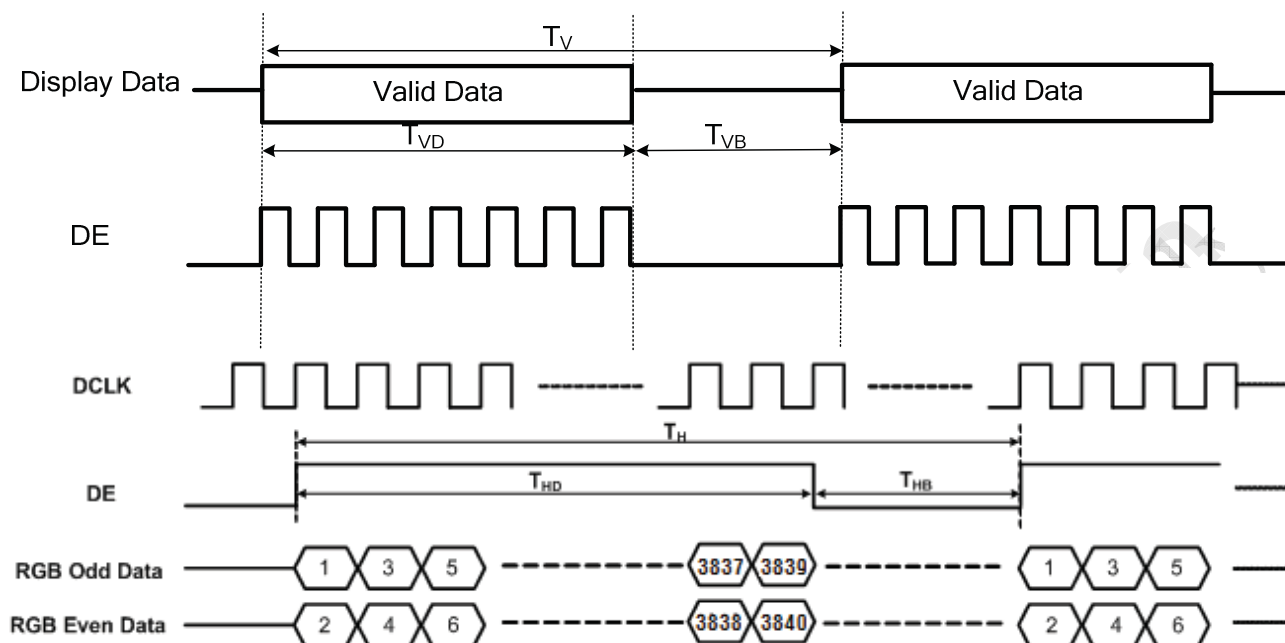


Fig. 3. Input Timing Diagram

| Parameter     |                         | Symbol              | Min.   | Typ.   | Max.  | Unit. | Remark |
|---------------|-------------------------|---------------------|--------|--------|-------|-------|--------|
| CLK Frequency |                         | $F_{CLK}$           | 175.52 | 177.84 | 184.5 | MHz   |        |
| HSYNC         | Period                  | $T_H$               | 3980   | 4000   | 4100  | CLK   |        |
|               | Horizontal display area | $T_{HD}$            | 3840   |        |       | CLK   |        |
|               | Blanking                | $T_{HBP} + T_{HFP}$ | 140    | 160    | 260   | CLK   |        |
| VSYNC         | Period                  | $T_V$               | 735    | 741    | 750   | HS    |        |
|               | Vertical display area   | $T_{VD}$            | 720    |        |       | HS    |        |
|               | Blanking                | $T_{VBP} + T_{VFP}$ | 15     | 21     | 30    | HS    |        |

## 6. Absolute Maximum Ratings

| Items                 | Symbol           | Values |          | Unit | Condition |
|-----------------------|------------------|--------|----------|------|-----------|
|                       |                  | Min.   | Max.     |      |           |
| Power Voltage         | VDD              | -0.3   | 3.9      | V    | GND = 0 V |
| Input Signal Voltage  | V <sub>i</sub>   | -0.3   | VDD+ 0.3 | V    | GND = 0 V |
| Operation Temperature | T <sub>opa</sub> | -30    | +85      | °C   | Ambient   |
| Storage Temperature   | T <sub>stg</sub> | -40    | +95      | °C   | Ambient   |

Note 1: Functional operation should be restricted under normal ambient temperature.

## 7. DC Electrical Characteristics

The following items are measured under stable condition and suggested application circuit.

### a. Power Specification

| Parameter    | Symbol              | Min | Typ  | Max  | Unit | Notes  |
|--------------|---------------------|-----|------|------|------|--------|
| Power Supply | VDD                 | 3.0 | 3.3  | 3.6  | V    | Note 1 |
|              | IVDD                |     | 1000 | 1300 | mA   | Note 1 |
|              | IVDD inrush current |     |      | 2500 | mA   | Note 1 |

\*\*\* The limitation range of Minima and Maxima is derived base on operating at ambient temp 25°C  
All conditions should be set typical value.



Fig. 4. Test pattern for power specification

### b. Touch Panel Driving Condition

| Parameter           | Symbol          | Min        | Typ. | Max.     | Unit | Notes         |
|---------------------|-----------------|------------|------|----------|------|---------------|
| Power Supply        | VDDD            | 3.0        | 3.3  | 3.6      | V    | ripple <100mV |
| Input high voltage  | V <sub>IH</sub> | 0.7*VDDD   | -    | -        | V    |               |
| Input low voltage   | V <sub>IL</sub> | -          | -    | 0.3*VDDD | V    |               |
| Output high voltage | V <sub>OH</sub> | VDDD – 0.6 | -    | -        | V    |               |
| Output low voltage  | V <sub>OL</sub> | -          | -    | 0.6      | V    |               |
| Supply current      | IVDDD           | -          | 37   | 48.2     | mA   |               |

### Single-end Signal

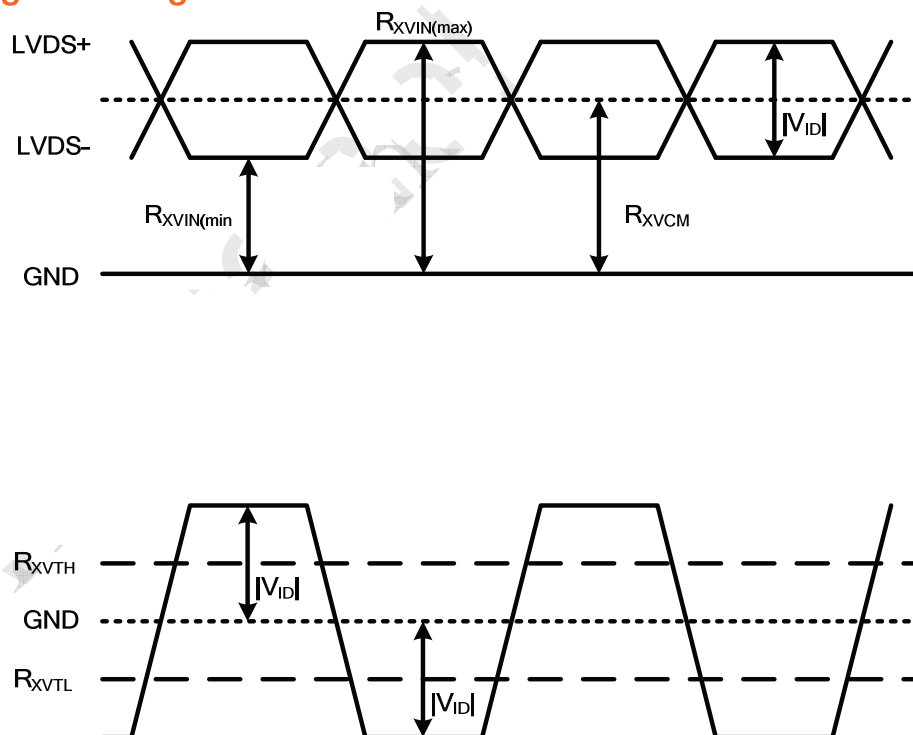


Fig. 5. LVDS DC characteristics diagram

### c. Backlight Driving Conditions (Note 1)

| Parameter          | Symbol | Condition            | Min.  | Typ. | Max. | Unit | Remark               |
|--------------------|--------|----------------------|-------|------|------|------|----------------------|
| LED Supply Current | $I_L$  | At 25°C              |       | 88   |      | mA   | single serial Note 3 |
| LED Supply Voltage | $V_L$  | IF=88(mA)<br>At 25°C |       | 33   | 37.8 | V    | single serial Note 3 |
| LED Life Time      | $L_L$  | At 25°C              | 15000 |      |      | hr   | Reference & Note 2   |

Note 1: Light-bar has 33 pieces of LED (3 strings, 11 pieces for each string).

Note 2: The LED lifetime 15000hrs means , after normal use at 88mA, under +25 ° C, the brightness decreases to 70% of original level.

Note 3: The LED supply power is for 6 string of LED(2 Light-bar).

Note 4: Be sure your system can provide enough voltage driving capability at driving condition -30°C (larger than 40.4 V is recommended) to provide 88mA for each LED or the brightness is possible to be below spec.

Note 5: LED current should follow below de-rating curve

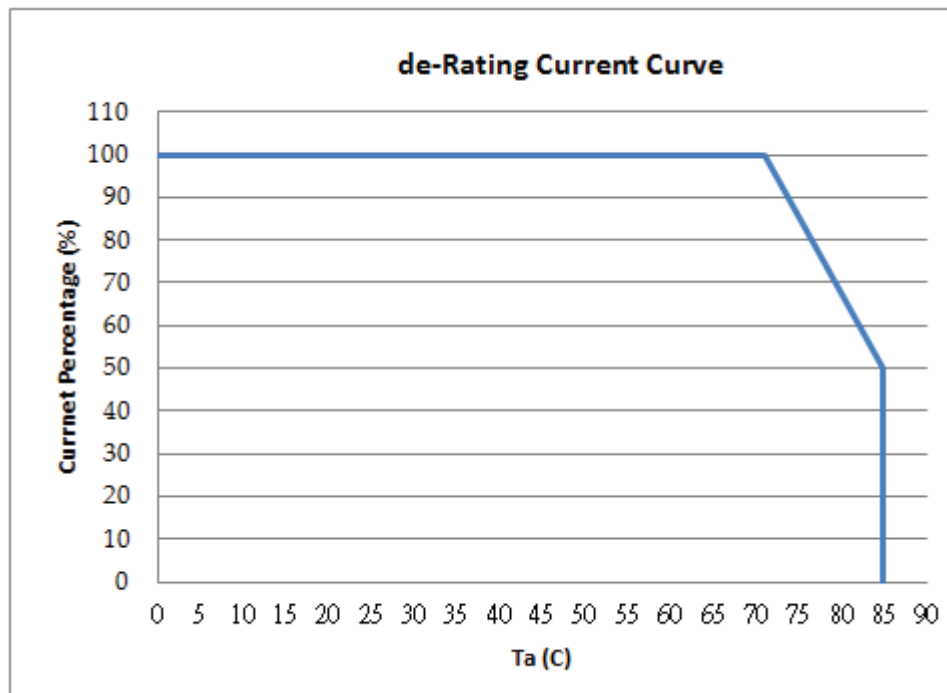


Fig. 6. Light bar structure

## 8. AC Electrical Characteristics

### a. Input AC characteristics

| Parameter              | Symbol    | Min. | Typ. | Max. | Unit | Remark                      |
|------------------------|-----------|------|------|------|------|-----------------------------|
| VDD power on slew time | $T_{POR}$ |      |      | 10   | ms   | From 0V to 90% VD<br>Note 1 |
| GRB active pulse width | $T_{GRB}$ | 1    |      |      | ms   | VDD=3.3V                    |

Note 1: the inrush current spec should follow VDD power on slew time min value is 1ms and max value is 15ms.  
Inrush current maybe out of spec.(max:500mA)

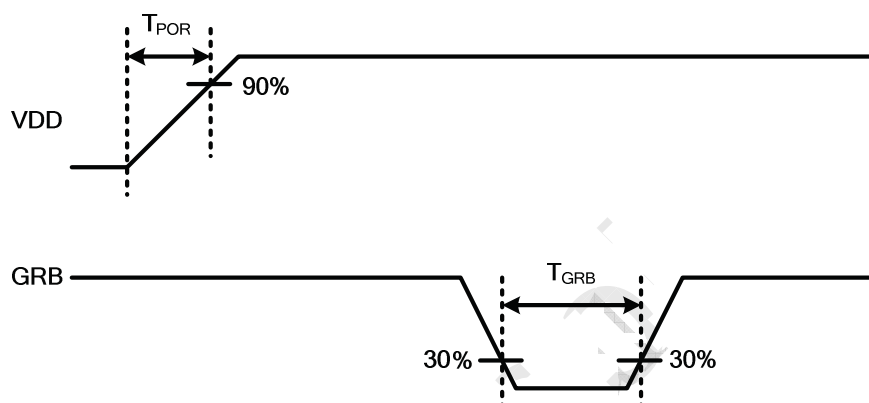


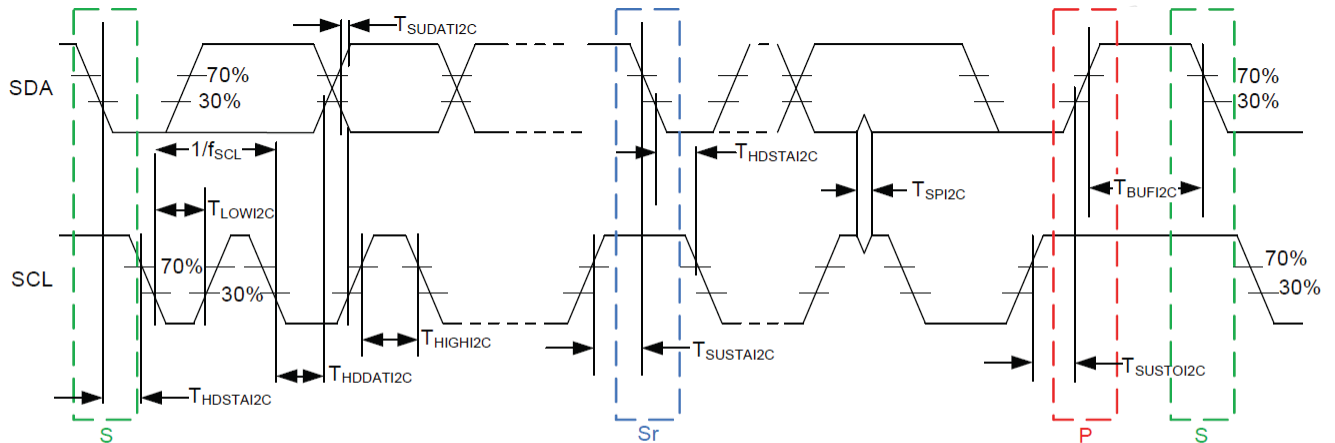
Fig. 7. VDD and GRB timing diagram

## 9. I2C Specification

| Parameter                   | Value  |
|-----------------------------|--------|
| Address                     | 0x24   |
| Maximum bus speed (I2C_SCL) | 400KHz |

**Note:** Pull-up Resistors(I2C\_SCL,I2C\_SDA,RESET) embedded at AUO Model.

Fig. 8 I2C Bus Timing Diagram for Fast/Standard Mode



### Legend

- S: I<sup>2</sup>C Start Condition
- Sr: I<sup>2</sup>C Repeat Start Condition
- P: I<sup>2</sup>C Stop Condition

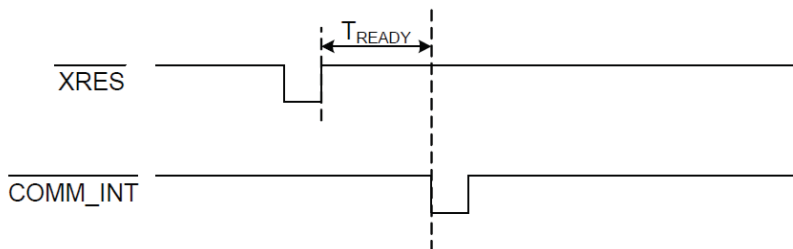
Table AC Characteristics of the I2C SDA and SCL Pins

| Symbol                | Description                                                                                         | Standard Mode         |                       | Fast Mode             |                       | Units |
|-----------------------|-----------------------------------------------------------------------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------|
|                       |                                                                                                     | Min                   | Max                   | Min                   | Max                   |       |
| f <sub>SCL</sub> I2C  | SCL clock frequency                                                                                 | 0                     | 100                   | 0                     | 400                   | kHz   |
| t <sub>HDSTAI2C</sub> | Hold time (repeated) start condition. After this period, the first clock pulse is generated.        | 4                     | –                     | 0.6                   | –                     | μs    |
| t <sub>LOWI2C</sub>   | LOW period of SCL clock                                                                             | 4.7                   | –                     | 1.3                   | –                     | μs    |
| T <sub>HIGHI2C</sub>  | HIGH period of SCL clock                                                                            | 4                     | –                     | 0.6                   | –                     | μs    |
| t <sub>SUSTAI2C</sub> | Setup time for repeated start condition                                                             | 4.7                   | –                     | 0.6                   | –                     | μs    |
| t <sub>HDDATI2C</sub> | Data hold time                                                                                      | 0                     | –                     | 0                     | –                     | μs    |
| t <sub>SUDATI2C</sub> | Data setup time                                                                                     | 250                   | –                     | 100                   | –                     | ns    |
| t <sub>VDDATI2C</sub> | Data valid time                                                                                     | –                     | 3.45                  | –                     | 0.9                   | μs    |
| t <sub>VDACKI2C</sub> | Data acknowledge time                                                                               | –                     | 3.45                  | –                     | 0.9                   | μs    |
| t <sub>SUSTOI2C</sub> | Setup time for stop condition                                                                       | 4                     | –                     | 0.6                   | –                     | μs    |
| V <sub>HH</sub>       | Input hysteresis high voltage, 1.71 V ≤ V <sub>DD</sub> ≤ 1.95 V or 3.0 V ≤ V <sub>DD</sub> ≤ 5.5 V | 0.1 × V <sub>DD</sub> | –                     | 0.1 × V <sub>DD</sub> | –                     | V     |
| t <sub>BUFI2C</sub>   | Bus free time between a stop and start condition                                                    | 4.7                   | –                     | 1.3                   | –                     | μs    |
| t <sub>SPi2C</sub>    | Pulse width of spikes that are suppressed by input filter                                           | –                     | –                     | 50                    | –                     | ns    |
| C <sub>BUS</sub>      | Capacitance load for SDA or SCL                                                                     | –                     | 400                   | –                     | 400                   | pF    |
| V <sub>IL</sub> I2C   | Input low voltage                                                                                   | –0.5                  | 0.3 × V <sub>DD</sub> | –0.5                  | 0.3 × V <sub>DD</sub> | V     |
| V <sub>IH</sub> I2C   | Input high voltage                                                                                  | 0.7 × V <sub>DD</sub> | –                     | 0.7 × V <sub>DD</sub> | –                     | V     |
| V <sub>OL</sub> I2C_L | Output low voltage (V <sub>DD</sub> ≤ 2 V, 3 mA sink)                                               | –                     | 0.2 × V <sub>DD</sub> | –                     | 0.2 × V <sub>DD</sub> | V     |
| V <sub>OL</sub> I2C_H | Output low voltage (V <sub>DD</sub> > 3 V, 3 mA sink)                                               | –                     | 0.4                   | –                     | 0.4                   | V     |
| I <sub>OL</sub> I2C   | Output low current                                                                                  | –                     | 3                     | –                     | 3                     | mA    |
|                       | Output low current V <sub>OL</sub> = 0.6 V                                                          | –                     | –                     | –                     | 6                     | mA    |
| V <sub>H</sub> I2C    | Input hysteresis                                                                                    | 0.1 × V <sub>DD</sub> | –                     | 0.1 × V <sub>DD</sub> | –                     | mV    |

## 10. Chip-Level AC Specification

| Symbol      | Description                                               | Conditions              | Min | Typ  | Max | Units   |
|-------------|-----------------------------------------------------------|-------------------------|-----|------|-----|---------|
| $T_{XRST}$  | External reset ( $\overline{XRES}$ ) pulse width          | After $V_{DD}$ is valid | 10  | –    | –   | $\mu s$ |
| $T_{READY}$ | Time from deassertion of $\overline{XRES}$ to $COMM\_INT$ | –                       | –   | –    | 35  | ms      |
| $T_{CAL}$   | Calibration routine execution time                        | –                       | –   | 2500 | –   | ms      |

Fig. 9  $COMM\_INT$  Timing Diagram



## 11. Detect and Status Register

### a. FAIL\_DET Pin

TCON output to FAIL\_DET Pin for informing the Fail occurrence.  
(Normal : High / Abnormal : Low)

When system detect fail occurrence, system can read TCON status register to understand which fail situation occurred.

### b. FAIL Status Register

TCON Support Fail Detect Function.

The Fail State Registers are capable to read from I<sup>2</sup>C Slave.

\*\*\*\*\_H are “Hold type register” that clearing command is needed after detection.

\*\*\*\*\_R are “Real Time type register” that reflect signal’s present condition.

**The Fail Status Register value “0” means “Normal Operation” and 1'b1 means “Fail Occurrence”**

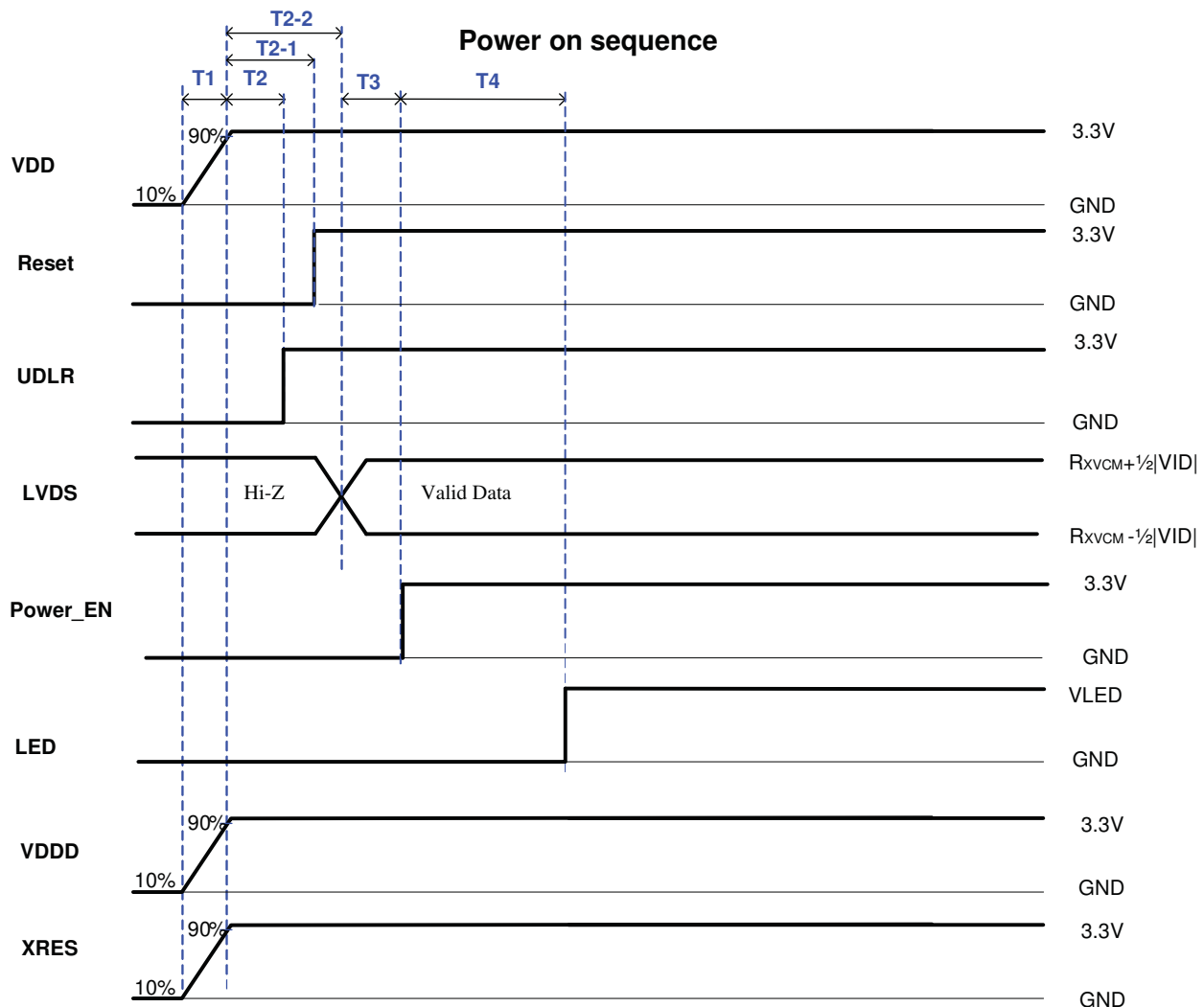
| State           | Description                                       | Address           |
|-----------------|---------------------------------------------------|-------------------|
| FAIL_DET_H/R    | FAIL_DET Signal                                   | 122h[0] / 13Dh[0] |
| DIO_FAIL_H/R    | DIO Feedback detection FAIL Signal.               | 122h[1] / 13Dh[1] |
| STV_FAIL_H/R    | STV Feedback detection FAIL Signal.               | 122h[2] / 13Dh[2] |
| DL_FAIL_H/R     | I <sup>2</sup> C/SPI Master Download FAIL Signal. | 122h[3] / 13Dh[3] |
| SYSTEM_FAIL_H/R | DE/Hsync/Vsync/LVDS CLK input FAIL.               | 122h[4] / 13Dh[4] |
| ML_FAIL_H/R     | mini-LVDS differential signal connectivity FAIL.  | 122h[5] / 13Dh[5] |
| EXT_FAIL1_H/R   | External Pin FAIL1 for PWM IC Fail Detect         | 123h[4] / 13Eh[4] |
| CHKSUM_FAIL_H/R | Checksum Fail of some of one parameter.           | 127h[7] / 142h[7] |

**Table 11-1. Status Register Table**

## 12. Power on/off sequence

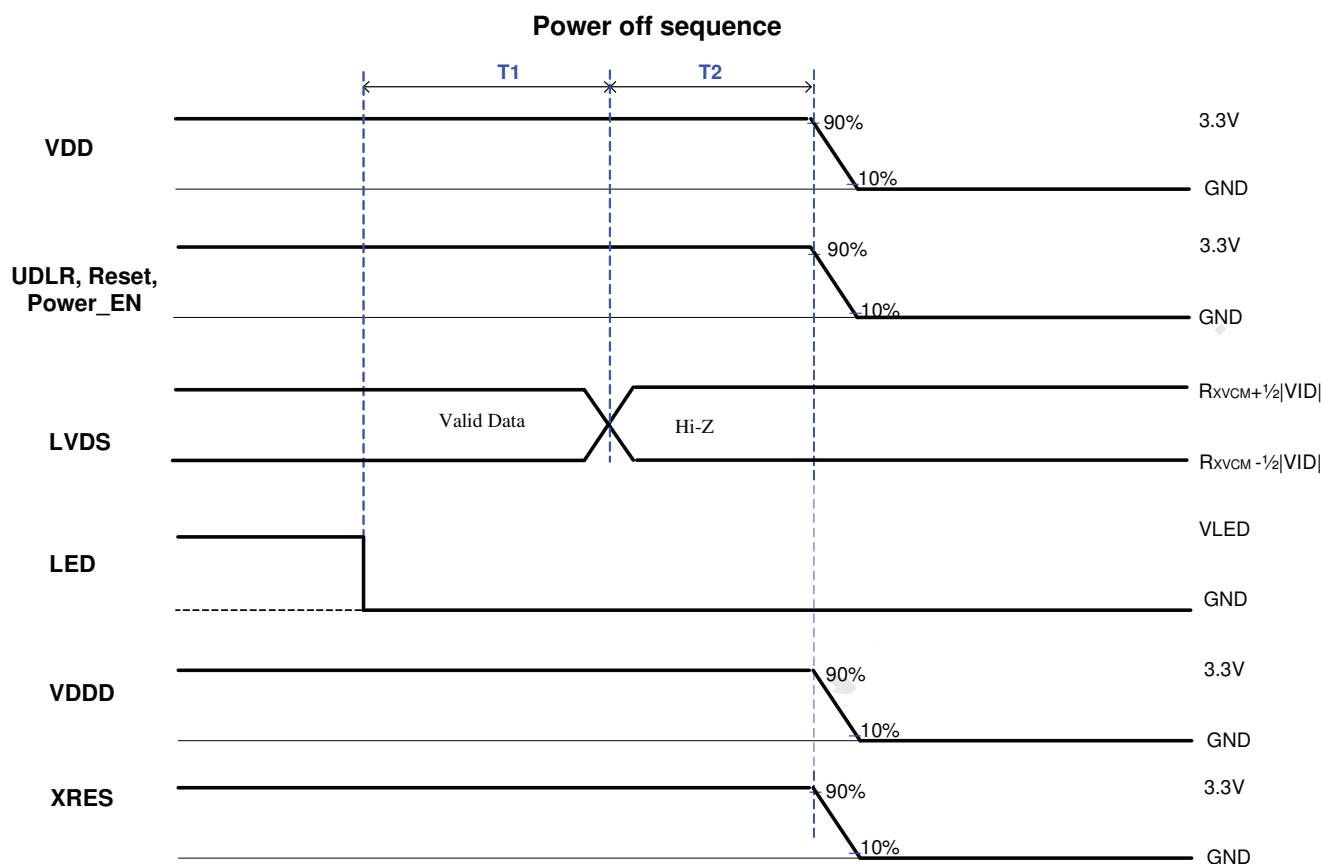
The LCD adopts high voltage driver IC, so it could be permanently damaged under a wrong power on/off sequence. The suggested LCD power sequence is below:

### a. Power on:



### Power on timing:

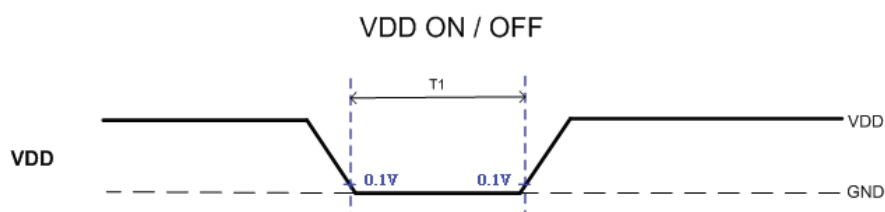
| Parameter | Value |      |      | Units |
|-----------|-------|------|------|-------|
|           | Min.  | Typ. | Max. |       |
| T1        | -     | -    | 10   | ms    |
| T2        | 0     | -    | -    | ms    |
| T2-1      | 3     | -    | -    | ms    |
| T2-2      | 0     | -    | -    | ms    |
| T3        | 0     | -    | -    | ms    |
| T4        | 400   | -    | -    | ms    |

**b. Power off:**

**Power off timing:**

| Parameter | Value |      |      | Units |
|-----------|-------|------|------|-------|
|           | Min.  | Typ. | Max. |       |
| T1        | 20    | -    | -    | ms    |
| T2        | 20    | -    | -    | ms    |

**c. Repower ON / OFF (other signal need to follow normal power on/off sequence)**

| Parameter | Value |      |      | Unit |
|-----------|-------|------|------|------|
|           | Min.  | Typ. | Max. |      |
| T1        | 400   | --   | -    | ms   |



## F. Optical specifications (all for reference)

| Item                                         | Symbol         | Condition          | Min.                 | Typ.   | Max.  | Unit              | Remark       |
|----------------------------------------------|----------------|--------------------|----------------------|--------|-------|-------------------|--------------|
| Response Time<br>Rise<br>Fall<br>(Ta= 25°C)  | Tr+Tf          | $\theta = 0^\circ$ | -<br>-               | -<br>- | 30    | ms                | Note 3       |
| Response Time<br>Rise<br>Fall<br>(Ta= -20°C) | Tr+Tf          | $\theta=0^\circ$   | -<br>-               |        | 200   | ms                | Note 3       |
| Response Time<br>Rise<br>Fall<br>(Ta= -30°C) | Tr+Tf          | $\theta=0^\circ$   | -<br>-               |        | 500   | ms                | Note 3       |
| Viewing Angle Top<br>Bottom<br>Left<br>Right |                | $CR \geq 10$       | 75<br>75<br>75<br>75 |        | -     | deg.              | Note 7, 8    |
| Contrast ratio                               | CR             | $\theta = 0^\circ$ | 900                  | 1100   | -     |                   | Note 4, 5, 6 |
| Brightness                                   | Y <sub>L</sub> | $\theta = 0^\circ$ | 600                  | 750    | -     | cd/m <sup>2</sup> | Note 9       |
|                                              |                | ID18 area          | 550                  |        |       |                   |              |
|                                              |                | ID19 area          | 240                  |        |       |                   |              |
|                                              |                | ID20 area          | 150                  |        |       |                   |              |
| White Chromaticity                           | X              | $\theta = 0^\circ$ | 0.256                | 0.296  | 0.336 |                   | Note 10      |
|                                              | Y              | $\theta = 0^\circ$ | 0.295                | 0.335  | 0.375 |                   |              |
| Red Chromaticity                             | X              | $\theta = 0^\circ$ | 0.633                | 0.673  | 0.713 |                   |              |
|                                              | Y              | $\theta = 0^\circ$ | 0.271                | 0.311  | 0.351 |                   |              |
| Green Chromaticity                           | X              | $\theta = 0^\circ$ | 0.257                | 0.297  | 0.337 |                   |              |
|                                              | Y              | $\theta = 0^\circ$ | 0.621                | 0.661  | 0.701 |                   |              |
| Blue Chromaticity                            | X              | $\theta = 0^\circ$ | 0.109                | 0.149  | 0.189 |                   |              |
|                                              | Y              | $\theta=0^\circ$   | 0.024                | 0.064  | 0.104 |                   |              |
| Uniformity                                   |                | -                  | 80                   |        |       | %                 | Note 11      |

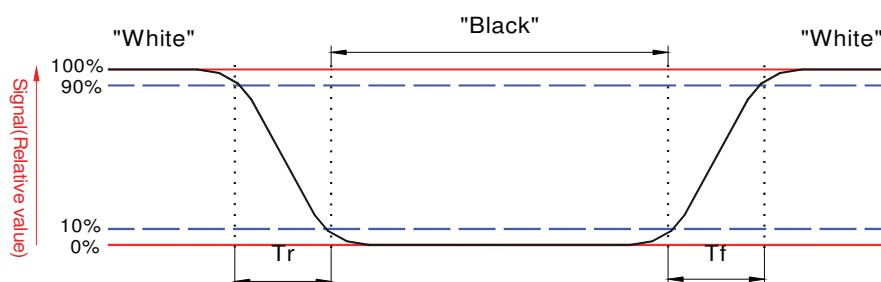
|             |  |  |  |     |           |   |        |
|-------------|--|--|--|-----|-----------|---|--------|
| Reflectance |  |  |  |     | 2.5+/-0.2 | % | @550nm |
| NTSC        |  |  |  | 86% |           |   |        |

Note 1: Measurement should be performed in the dark room, optical ambient temperature = 25 °C, and backlight current  $I_L = 80\text{mA}$ .

Note 2: To be measured in the center area of TFT-LCD with a field angle of 1° by Topcon luminance meter SR3, after 10 minutes operation and warm up 30 minutes.

Note 3: Definition of response time:

The output signals of photo detector are measured when the input signals are changed from "black state" to "white state" (falling time) and from "white state" to "black state" (rising time), respectively.



Note 4: Based on liquid crystal characteristics, the response time will become slower and the color of panel will become darker than the above optical specification when ambient temperature is below 25 °C.

Note 5: Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio} = \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector output when LCD is at "Black" state}}$$

Note 6: White Vdata=V1 or V18

Black Vdata=V9 or V10

(For definition of V1, V9, V10 & V18, please refer to Appendix )

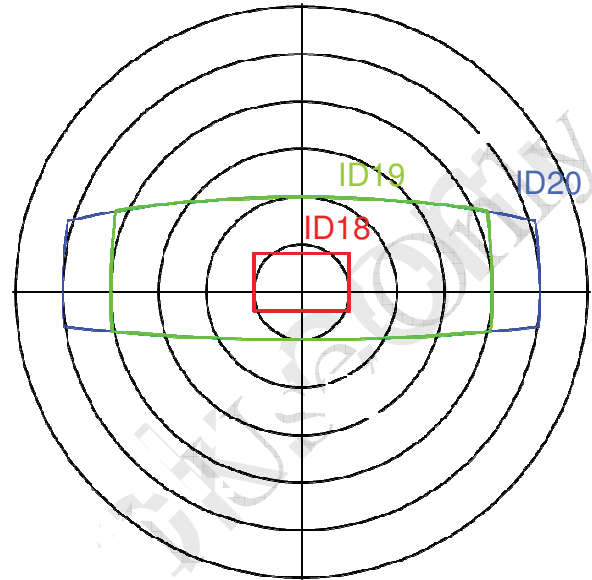
The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 7: Definition of viewing angle: refer to figure as below.

Note 8: Viewing angles are measured at the center of the panel when all the input terminals of LCD oanel are electrically opened.

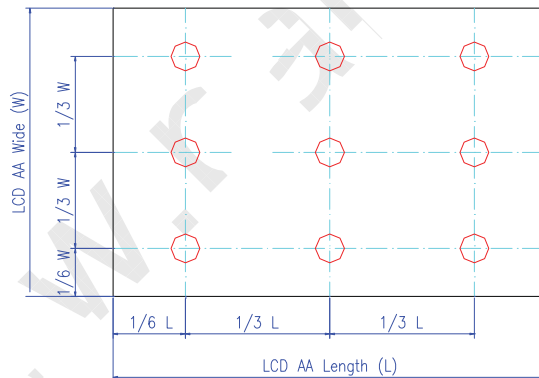
Note 9: For the definition of ID18 area, ID19 area and ID20 area, please refer to below viewing angle for explanation.

- ID18  $\pm 10^\circ$  horizontal,  $+8^\circ / -4^\circ$  vertical
- ID19  $\pm 40^\circ$  horizontal,  $+20^\circ / -10^\circ$  vertical
- ID20  $\pm 50^\circ$  horizontal,  $+20^\circ / -10^\circ$  vertical



Note 10: The viewing angles are measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Note 11: Luminance Uniformity of these 9 points is defined as below: (1 : 2 : 2 : 1)



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

### G. Reliability Test Items(Note 1~3)

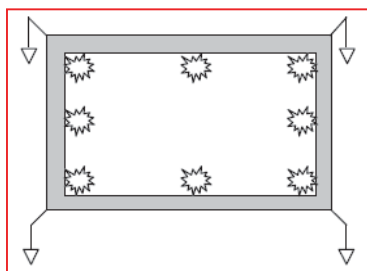
| No. | Test items                         | Conditions                                                                                                                                                                    |                     | Remark                     |
|-----|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------------|
| 1   | High temperature storage           | Ta= 95 °C                                                                                                                                                                     | 500 Hrs             | Note1,2, 5<br>Note1,2,3, 5 |
| 2   | Low temperature storage            | Ta= -40 °C                                                                                                                                                                    | 500 Hrs             |                            |
| 3   | High temperature operation         | Ta= 85 °C                                                                                                                                                                     | 500 Hrs             |                            |
| 4   | Low temperature operation          | Ta= -30 °C                                                                                                                                                                    | 500 Hrs             |                            |
| 5   | High temperature and high humidity | Ta= 60 °C , 90 % RH                                                                                                                                                           | 500 Hrs             | Note1,2,3,5<br>Operation   |
| 6   | Heat shock                         | -40 °C ~ 85 °C / 200 cycles 1 Hrs/cycle                                                                                                                                       |                     | Note1,2,3,5                |
| 7   | Shock                              | 100 G, 6 ms, ±X, ±Y, ±Z<br>3 times for each direction                                                                                                                         |                     |                            |
| 8   | Electrostatic Discharge            | Contact = ± 4 kV, class A (R=330Ω,C=150pF)<br>Air = ± 4 kV, class A (R=330Ω,C=150pF)<br>Contact = ± 8 kV, class B (R=330Ω,C=150pF)<br>Air = ± 15 kV, class B (R=330Ω,C=150pF) |                     | Operation<br>(Note 4)      |
| 9   | Vibration                          | Frequency range                                                                                                                                                               | 8 ~ 33.3 Hz         |                            |
|     |                                    | Stoke                                                                                                                                                                         | 1.3 mm              |                            |
|     |                                    | Sweep                                                                                                                                                                         | 2.9 G, 33.3 ~ 400Hz |                            |
|     |                                    | Cycle                                                                                                                                                                         | 15 min.             |                            |
|     |                                    | 2 hours for each direction of X, Z<br>4 hours for Y direction                                                                                                                 |                     |                            |
| 10  | Vibration (with carton)            | Random vibration:<br>0.015 G <sup>2</sup> /Hz from 5 ~ 200 Hz<br>-6 dB/Octave from 200 ~ 500 Hz                                                                               |                     |                            |
| 11  | Drop (with carton)                 | Height: 60 cm<br>1 corner, 3 edges, 6 surfaces                                                                                                                                |                     |                            |
| 12  | Image Sticking                     | 10x10 chess pattern 2hr@ L128 pattern judge,<br>after 3 minutes later                                                                                                         |                     | Note 6                     |

Note 1: Ta: Ambient temperature

Note 2: In the standard condition, there is no display function NG issue occurred. All the cosmetic specification is judged before the reliability stress. inspection environment is room temperature: 25±5

Note 3: I<sub>L</sub> = 88mA

Note 4: Test techniques follow IEC61000-4-2 standard  
Class A –Normal operation. No degradation. No failures



Note 5: These items are for customer component-level validation test only in design stage, they will be done in design stage before PPAP only, not for MP stage. Test criteria will be judged as without electrical functional defect.

Note6: Image Sticking.

Condition of Image Sticking test :  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$  ; Operation with test pattern sustained for 2 hrs, then change to gray pattern immediately., invisible after 3 minutes later (invisible mean the limit sample approval with Harman and AUO)

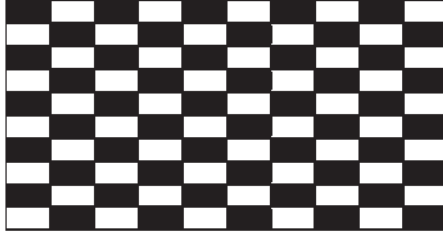


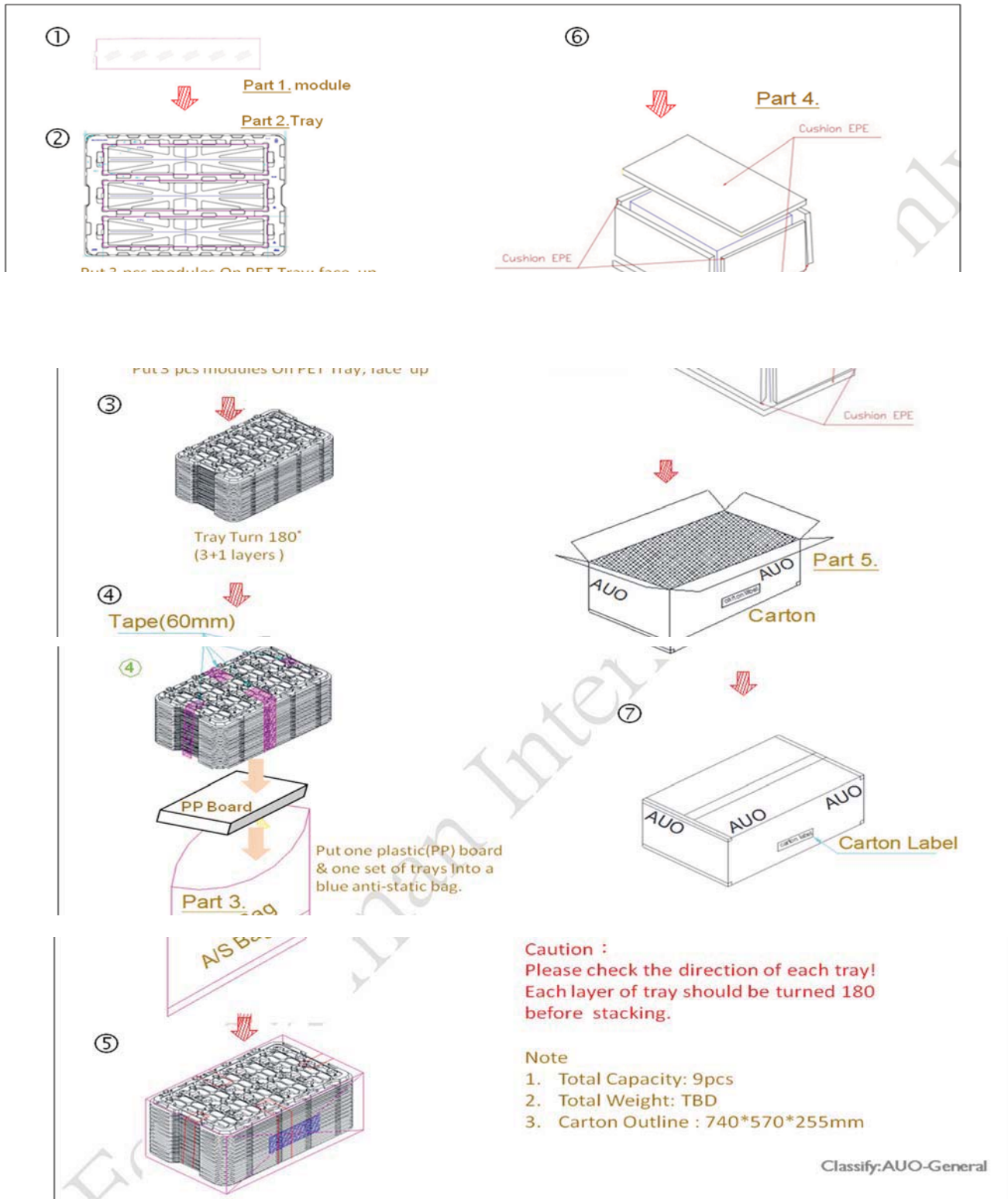
Image sticking pattern



128 Gray pattern

## H. Packing and Marking

### 1. Packing Form



## 2. Module/Panel Label Information

The module/panel (collectively called as the “Product”) will be attached with a label of Shipping Number which represents the identification of the Product at a specific location. Refer to the Product outline drawing for detailed location and size of the label. The label is composed of a 22-digit serial number with the following definition:



**ABCDEFGHIJKLMN**

- For internal system usage and production serial numbers.
- AUO Module or Panel factory code, represents the final production factory to complete the Product
- Product version code, ranging from 0~9 or A~Z (for Version after 9)
- Week Code, the production week when the product is finished at its production process

Example:

501M06ZL06123456781Z05:

Product Manufacturing Week Code: WK50

Product Version: Version 1

Product Manufacturing Factory: M06

**229030000001010103562931**

- SNR : 03562931 (8 digits ; fixed)
- HAD Module Number Code = 01 (2digits) Code = fixed
- HAD EC- level (correct EC- Level will be descript in ,Product History sheet“ (2 digits) Code = variable
- Serial Number (consecutively numbered) (9digits) Code = variable ;From 100000001 ~ 03 for BJEV N60 C203RAT01.0
- supplier Code = XXX(3 digits) for AUO , Code = fixed

## 3. Carton Label Information

The packing carton will be attached with a carton label where packing Q'ty, AUO Model Name, AUO Part Number, Customer Part Number (Optional) and a series of Carton Number in 13 or 14 digits are printed. The Carton Number is appearing in the following format:

**ABC-DEFG-HIJK-LMN**

- DEFG appear after first "-" represents the packing date of the carton
- Date from 01 to 31
- Month, ranging from 1~9, A~C. A for Oct, B for Nov and C for Dec.
- A.D. year, ranging from 1~9 and 0. The single digit code represents the last number of the year

Refer to the drawing of packing format for the location and size of the carton label.

#### 4. Warehouse storage condition:

When storing modules as spares for a period, the following precautions are necessary

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light.
  - a) Keep the temperature between 20℃ and 30℃ at normal humidity(30%~70%) with a period no longer than 3 months as recommended condition.
  - b) Keep the temperature at 60℃ and 60%RH with a period no longer than 1 month as recommended condition.

#### 5. Precautions

Recommended mounting situation

- (1) The module should be installed with the designed mounting structure.
- (2) Unequal force between each mounting structure is not allowed.
- (3) Once the mounting structure is fixed, it should have the capability to prevent any external force been applied to the module.

#### I. Precautions

Please pay attention to the following items when you use the LCD Modules:

- 1. Do not twist or bend the module and prevent the unsuitable external force for display module during assembly.
- 2. Adopt measures for good heat radiation. Be sure to use the module with in the specified temperature.
- 3. Avoid dust or oil mist during assembly.
- 4. Follow the correct power sequence while operating. Do not apply the invalid signal, otherwise, it will cause improper shut down and damage the module.
- 5. Less EMI: it will be more safety and less noise.
- 6. Please operate module in suitable temperature. The response time & brightness will drift by different temperature.
- 7. Avoid being displayed the fixed pattern (exclude the white pattern) in a long period, otherwise, it will cause image sticking.
- 8. Be sure to turn off the power when connecting or disconnecting the circuit.
- 9. Polarizer scratches
- 10. Display surface never likes dirt or stains.
- 11. Dew may lead to destruction. Please wipe off any moisture before using module.
- 12. Sudden temperature changes cause condensation, and it will cause polarizer damaged.
- 13. High temperature and humidity may degrade performance. Please do not expose the module to the direct sunlight and so on.
- 14. Acetic acid or chlorine compounds are not friends with TFT display module.
- 15. Static electricity will damage the module, please do not touch the module without any grounded device.
- 16. Do not disassemble and reassemble the module by self.
- 17. Be careful do not touch the rear side directly.
- 18. No strong vibration or shock. It will cause module broken.

19. Storage the modules in suitable environment with regular packing.
20. Be careful of injury from a broken display module.
21. Please avoid the pressure adding to the surface (front or rear side) of modules, because it will cause the display non-uniformity or other function issue.