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# Datasheet

**AUO**

**P280HVN02.0**

UP-02-133

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# Model Name: P280HVN02.0

Issue Date : 2015/08/11

( ) Preliminary Specifications  
(\* ) Final Specifications

| Customer Signature | Date | AUO                                       | Date                |
|--------------------|------|---|---------------------|
| Approved By        |      | Approval By PM Director<br>Kelly Kao      | <i>Kelly Kao</i>    |
| Note               |      | Reviewed By RD Director<br>Eugene CC Chen | <i>陳品川</i>          |
|                    |      | Reviewed By Project Leader<br>KCH Peng    |                     |
|                    |      | Prepared By PM<br>Travis Huang            | <i>Travis Huang</i> |

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## 1. General Description

This specification applies to the 28.0 inch Color TFT-LCD Module P280HVN02.0. This LCD module contains TFT active matrix type liquid crystal panel 1,920x358 pixels, and diagonal size of 28.0 inch. This module supports 1,920x358 mode. Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot. The P280HVN02.0 has been designed to apply the 8-bit 2 channel LVDS interface method. It is intended to support displays where high brightness, wide viewing angle, high color saturation, and high color depth.

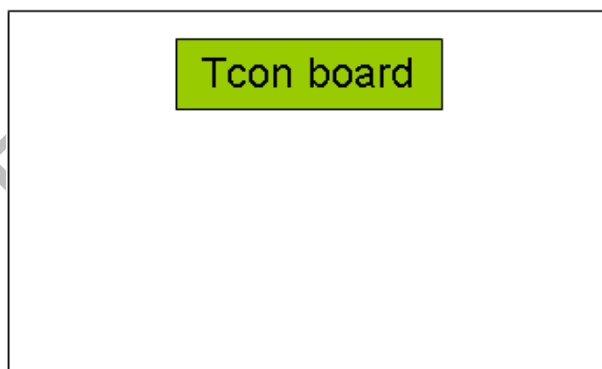
### \* General Information

| Items                  | Specification                   | Unit   | Note      |
|------------------------|---------------------------------|--------|-----------|
| Active Screen Size     | 28.0                            | Inch   |           |
| Display Area           | 698.4(H) x 129.86(V)            | mm     |           |
| Outline Dimension      | 733.78(H) x 165.34(V) x 17.9(D) | mm     | 1         |
| Driver Element         | a-Si TFT active matrix          |        |           |
| Display Colors         | 8 bit, 16.7M                    | Colors |           |
| Number of Pixels       | 1,920x358                       | Pixel  | 3         |
| Pixel Pitch            | 0.3637 (H) x 0.3637(W)          | mm     |           |
| Pixel Arrangement      | RGB vertical stripe             |        |           |
| Display Operation Mode | Normally Black                  |        |           |
| Display Orientation    | Landscape/Portrait Enable       |        |           |
| Surface Treatment      | AG, Hardness 3H                 |        | Haze = 2% |

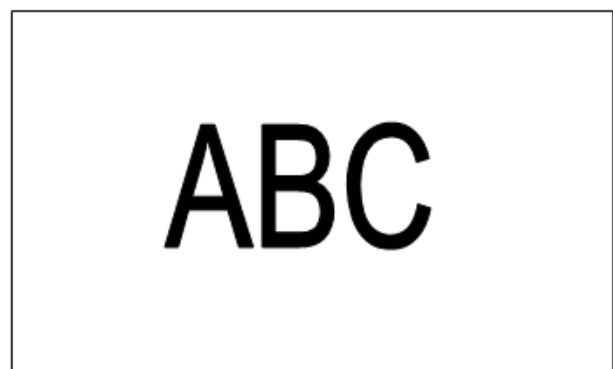
Note:

- (1) D: 17.9 mm (front bezel to CB Cover)
- (2) LCD display as below illustrated when signal input with "ABC"
- (3) Active Timing (H) needs to be set as 1920\*1080.

Rear side



Front side



## 2. Absolute Maximum Ratings

The followings are maximum values which, if exceeded, may cause faulty operation or damage to the unit

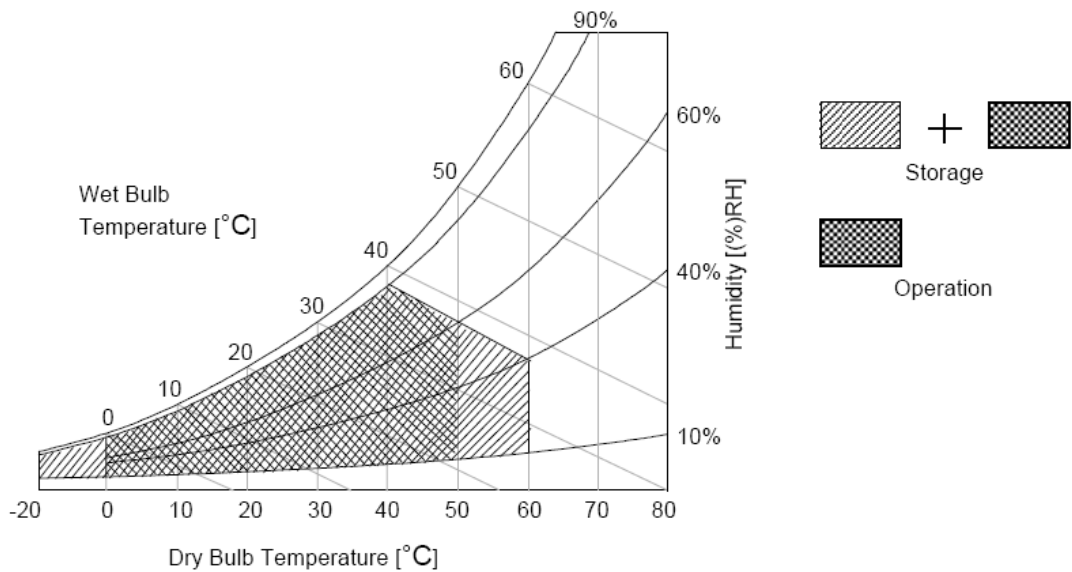
| Item                      | Symbol | Min  | Max | Unit   | Conditions |
|---------------------------|--------|------|-----|--------|------------|
| Logic/LCD Drive Voltage   | Vcc    | -0.3 | 14  | [Volt] | Note 1     |
| Input Voltage of Signal   | Vin    | -0.3 | 4   | [Volt] | Note 1     |
| Operating Temperature     | TOP    | 0    | +50 | [°C]   | Note 2     |
| Operating Humidity        | HOP    | 20   | 80  | [%RH]  | Note 2     |
| Storage Temperature       | TST    | -20  | +60 | [°C]   | Note 2     |
| Storage Humidity          | HST    | 20   | 80  | [%RH]  | Note 2     |
| Panel Surface Temperature | PST    |      | 65  | [°C]   | Note 3     |

Note 1: Duration:50 msec.

Note 2 : Maximum Wet-Bulb should be 39°C and No condensation.

The relative humidity must not exceed 90% non-condensing at temperatures of 40°C or less. At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C.

Note 3: Surface temperature is measured at 50°C Dry condition



FOR

### 3. Electrical Specification

The LVDS input of P280HVN02.0 needs FHD input. The data input needs to be FHD.

#### 3.1.1 Electrical Characteristics

| Parameter   |   | Symbol             | Value |       |                | Unit         | Note |
|---|---|--------------------|-------|-------|----------------|--------------|------|
|   |   |                    | Min.  | Typ.  | Max            |              |      |
| LCD   |   |                    |       |       |                |              |      |
| Power Supply Input Voltage  |   | $V_{DD}$           | 10.8  | 12    | 13.2           | $V_{DC}$     |      |
| Power Supply Input Current  |   | $I_{DD}$           | --    | 0.39  | 0.56           | A            | 1    |
| Power Consumption   |   | $P_C$              | --    |       | 5              | Watt         | 1    |
| Inrush Current  |   | $I_{RUSH}$         | -     |       | 4              | A            | 2    |
| Permissible Ripple of Power Supply Input Voltage<br>(for input power=12V) |   | $V_{RP}$           | --    | --    | $V_{DD} * 5\%$ | $mV_{pk-pk}$ | 3    |
| LVDS Interface  | Input Differential Voltage                | $ V_{ID} $         | 200   | 400   | 600            | $mV_{DC}$    | 4    |
|   | Differential Input High Threshold Voltage | $V_{TH}$           | +100  | --    | +300           | $mV_{DC}$    | 4    |
|   | Differential Input Low Threshold Voltage  | $V_{TL}$           | -300  | --    | -100           | $mV_{DC}$    | 4    |
|   | Input Common Mode Voltage                 | $V_{ICM}$          | 1.1   | 1.25  | 1.4            | $V_{DC}$     | 4    |
| CMOS Interface  | Input High Threshold Voltage              | $V_{IH}$<br>(High) | 2.7   | --    | 3.3            | $V_{DC}$     | 7    |
|   | Input Low Threshold Voltage               | $V_{IL}$<br>(Low)  | 0     | --    | 0.6            | $V_{DC}$     |      |
| Backlight Power Consumption   |   | $P_{BL}$           | --    | 39.0  |                | W            |      |
| Life Time(MTTF)   |   |                    | 50000 | 70000 |                | --           | 8    |

#### 3.1.2 AC Characteristics

| Parameter      |  | Symbol  | Value        |          |            | Unit | Note |
|----------------|--|---------|--------------|----------|------------|------|------|
|                |  |         | Min.         | Typ.     | Max        |      |      |
| LVDS Interface | Receiver Clock : Spread Spectrum Modulation range            | Fclk_ss | Fclk -3%     | --       | Fclk +3%   | MHz  | 9    |
|                | Receiver Clock : Spread Spectrum Modulation frequency        | Fss     | 30           | --       | 200        | KHz  | 9    |
|                | Receiver Data Input Margin<br>Fclk = 85 MHz<br>Fclk = 65 MHz | tRMG    | -0.4<br>-0.5 | --<br>-- | 0.4<br>0.5 | ns   | 10   |



### 3.1.3 Driver Characteristics

| Item                       | Symbol | Min | Max | Unit | condition |
|----------------------------|--------|-----|-----|------|-----------|
| Driver Surface Temperature | DST    |     | 100 | [°C] | Note      |

**Note :** Any point on the driver surface must be less than 100°C under any conditions.

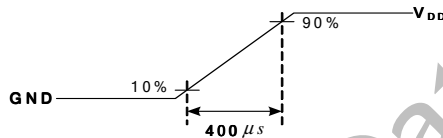
### 3.1.4 TCON Characteristics

| Item                     | Symbol | Min | Max | Unit | condition |
|--------------------------|--------|-----|-----|------|-----------|
| TCON Surface Temperature | TST    |     | 85  | [°C] | Note      |

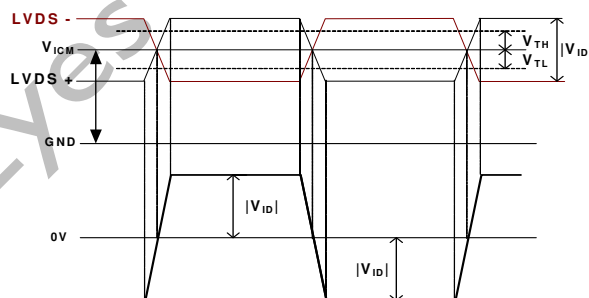
**Note:** Any point on the TCON surface must be less than 85°C under any conditions.

**Note :**

- Test Condition:
  - $V_{DD} = 12.0V$
  - $F_v =$  Type Timing, 60Hz, 120Hz or Other
  - $F_{CLK} =$  Max freq.
  - Temperature = 25 °C
  - Test Pattern : White Pattern
- Measurement condition : Rising time = 400us



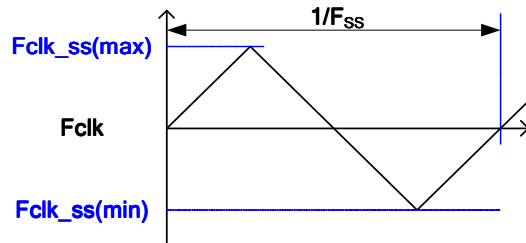
- Test Condition:
  - The measure point of  $V_{RP}$  is in LCM side after connecting the System Board and LCM.
  - Under Max. Input current spec. condition.
- $V_{ICM} = 1.25V$



- Do not attach a conducting tape to lamp connecting wire. If the lamp wire attach to conducting tape, TFT-LCD Module have a low luminance and the inverter has abnormal action because leakage current occurs between lamp wire and conducting tape.
- The relative humidity must not exceed 80% non-condensing at temperatures of 40°C or less. At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C. When operate at low temperatures, the brightness of LED will drop and the life time of LED will be reduced.
- The measure points of  $V_{IH}$  and  $V_{IL}$  are in LCM side after connecting the System Board and LCM.

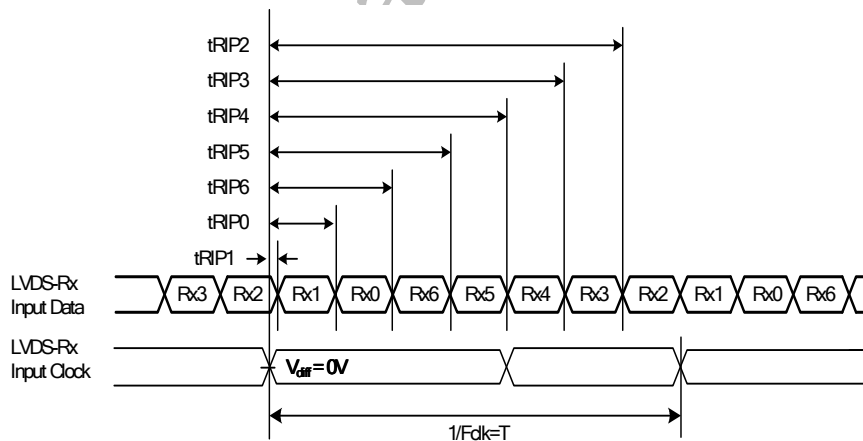
8. The lifetime (MTTF) is defined as the time which luminance of the LED is 50% compared to its original value. [Operating condition: Continuous operating at  $T_a = 25 \pm 2^\circ\text{C}$ ]

9. LVDS Receiver Clock SSCG (Spread spectrum clock generator) is defined as below figures

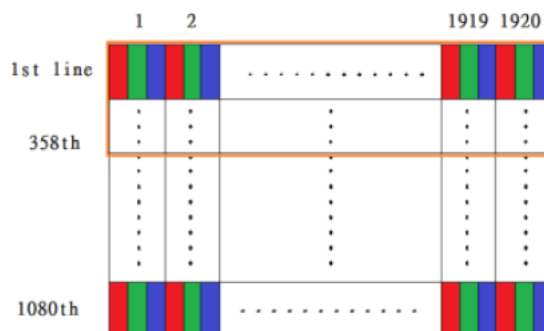


10. Receiver Data Input Margin

| Parameter             | Symbol | Rating          |        |                 | Unit | Note       |
|-----------------------|--------|-----------------|--------|-----------------|------|------------|
|                       |        | Min             | Type   | Max             |      |            |
| Input Clock Frequency | Fclk   | Fclk (min)      | --     | Fclk (max)      | MHz  | $T=1/Fclk$ |
| Input Data Position0  | tRIP1  | - tRMG          | 0      | tRMG            | ns   |            |
| Input Data Position1  | tRIP0  | $T/7 -  tRMG $  | $T/7$  | $T/7 +  tRMG $  | ns   |            |
| Input Data Position2  | tRIP6  | $2T/7 -  tRMG $ | $2T/7$ | $2T/7 +  tRMG $ | ns   |            |
| Input Data Position3  | tRIP5  | $3T/7 -  tRMG $ | $3T/7$ | $3T/7 +  tRMG $ | ns   |            |
| Input Data Position4  | tRIP4  | $4T/7 -  tRMG $ | $4T/7$ | $4T/7 +  tRMG $ | ns   |            |
| Input Data Position5  | tRIP3  | $5T/7 -  tRMG $ | $5T/7$ | $5T/7 +  tRMG $ | ns   |            |
| Input Data Position6  | tRIP2  | $6T/7 -  tRMG $ | $6T/7$ | $6T/7 +  tRMG $ | ns   |            |



11. Please input the black signal after line 359 to avoid the unexpected image.



### 3.2 Interface Connections

● LCD connector : JAE FI-RE51S-HF (JAE)

| PIN | Symbol   | Description                                   | PIN | Symbol          | Description                     |
|-----|----------|---|-----|-----------------|---------------------------------|
| 1   | Open     | No connection (Internal Open)                 | 26  | GND             | Ground                          |
| 2   | N.C.     | AUO Internal Use Only                         | 27  | GND             | Ground                          |
| 3   | N.C.     | AUO Internal Use Only                         | 28  | CH2_0-          | LVDS Channel 2, Signal 0-       |
| 4   | N.C.     | AUO Internal Use Only                         | 29  | CH2_0+          | LVDS Channel 2, Signal 0+       |
| 5   | N.C.     | AUO Internal Use Only                         | 30  | CH2_1-          | LVDS Channel 2, Signal 1-       |
| 6   | N.C.     | AUO Internal Use Only                         | 31  | CH2_1+          | LVDS Channel 2, Signal 1+       |
| 7   | LVDS_SEL | Open/High(3.3V) for NS,<br>Low(GND) for JEIDA | 32  | CH2_2-          | LVDS Channel 2, Signal 2-       |
| 8   | N.C.     | No connection                                 | 33  | CH2_2+          | LVDS Channel 2, Signal 2+       |
| 9   | N.C.     | No connection                                 | 34  | GND             | Ground                          |
| 10  | GND      | Ground  | 35  | CH2_CLK-        | LVDS Channel 2, Clock -         |
| 11  | GND      | Ground  | 36  | CH2_CLK+        | LVDS Channel 2, Clock +         |
| 12  | CH1_0-   | LVDS Channel 1, Signal 0-                     | 37  | GND             | Ground                          |
| 13  | CH1_0+   | LVDS Channel 1, Signal 0+                     | 38  | CH2_3-          | LVDS Channel 2, Signal 3-       |
| 14  | CH1_1-   | LVDS Channel 1, Signal 1-                     | 39  | CH2_3+          | LVDS Channel 2, Signal 3+       |
| 15  | CH1_1+   | LVDS Channel 1, Signal 1+                     | 40  | N.C.            | AUO Internal Use Only           |
| 16  | CH1_2-   | LVDS Channel 1, Signal 2-                     | 41  | N.C.            | AUO Internal Use Only           |
| 17  | CH1_2+   | LVDS Channel 1, Signal 2+                     | 42  | GND             | Ground                          |
| 18  | GND      | Ground  | 43  | GND             | Ground                          |
| 19  | CH1_CLK- | LVDS Channel 1, Clock -                       | 44  | GND             | Ground                          |
| 20  | CH1_CLK+ | LVDS Channel 1, Clock +                       | 45  | GND             | Ground                          |
| 21  | GND      | Ground  | 46  | GND             | Ground                          |
| 22  | CH1_3-   | LVDS Channel 1, Signal 3-                     | 47  | N.C.            | No connection                   |
| 23  | CH1_3+   | LVDS Channel 1, Signal 3+                     | 48  | V <sub>DD</sub> | Power Supply, +12V DC Regulated |
| 24  | N.C.     | AUO Internal Use Only                         | 49  | V <sub>DD</sub> | Power Supply, +12V DC Regulated |
| 25  | N.C.     | AUO Internal Use Only                         | 50  | V <sub>DD</sub> | Power Supply, +12V DC Regulated |
|     |          |   | 51  | V <sub>DD</sub> | Power Supply, +12V DC Regulated |

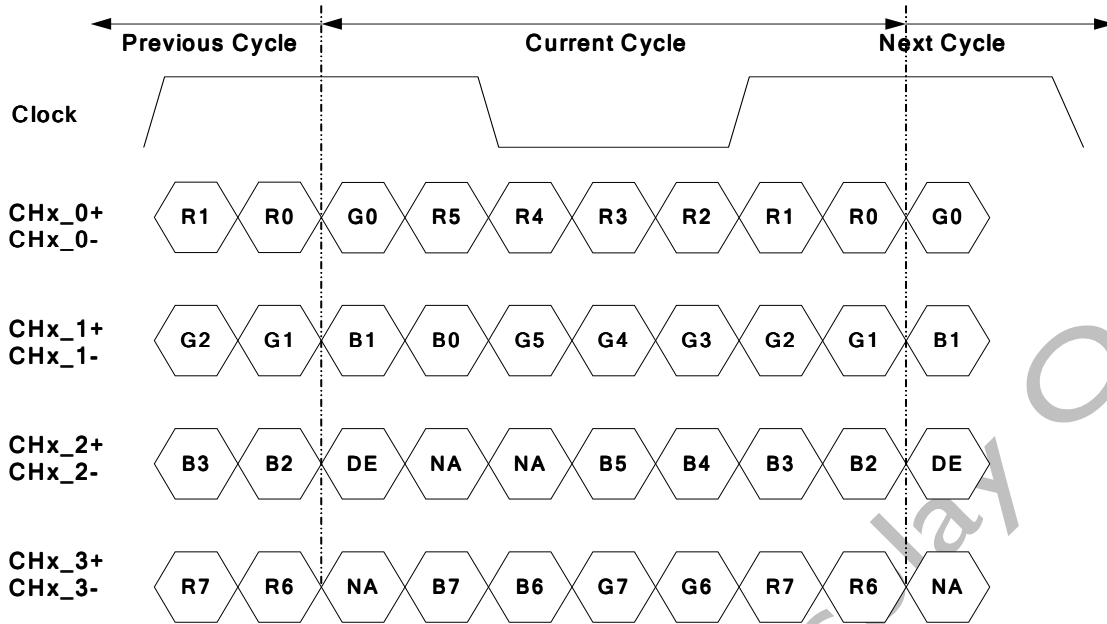
Note 1: All GND (ground) pins should be connected together and should also be connected to the LCD's metal frame.

Note 2: All V<sub>DD</sub> (power input) pins should be connected together.

Note 3: All NC (no connection) pins please leave this pin unoccupied. It can not be connected by any signal (Low/GND/High).

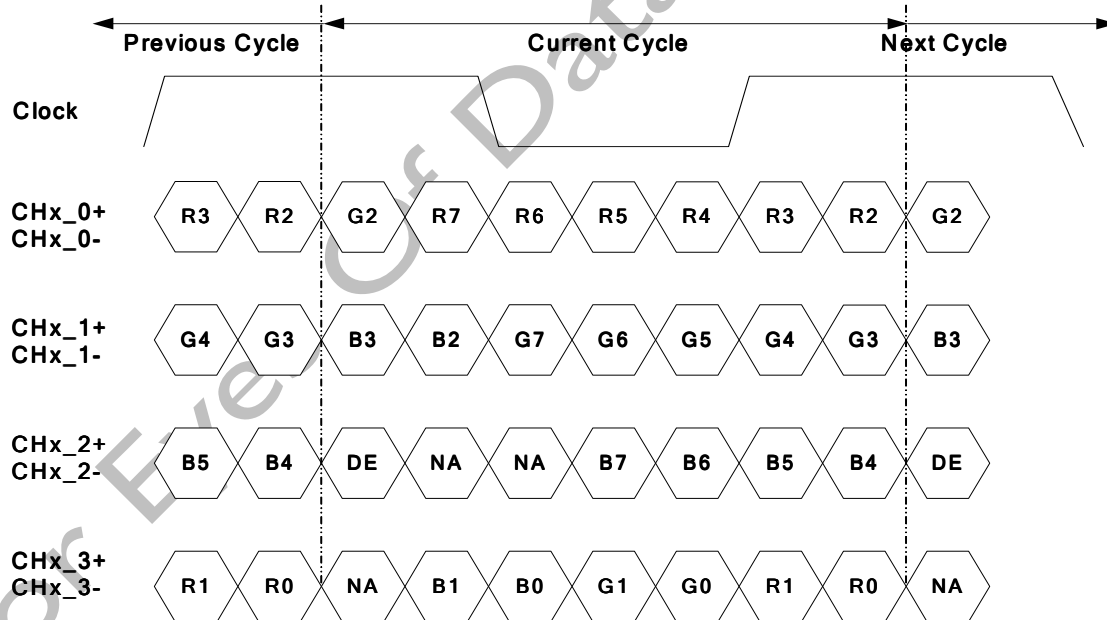
**LVDS Option for 8bit**

LVDS Option = High/Open → NS



Note: x = 1, 2, 3, 4...

**LVDS Option = Low → JEIDA**



Note: x = 1, 2, 3, 4...

### 3.3 Signal Timing Specification

This is the signal timing required at the input of the user connector. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

#### Timing Table (DE only Mode)

##### Vertical Frequency Range (60Hz)

| Signal               | Item      | Symbol      | Min. | Typ.  | Max  | Unit |
|----------------------|-----------|-------------|------|-------|------|------|
| Vertical Section     | Period    | Tv          | 1096 | 1125  | 1480 | Th   |
|                      | Active    | Tdisp (v)   | 1080 |       |      | Th   |
|                      | Blanking  | Tblk (v)    | 16   | 45    | 400  | Th   |
| Horizontal Section   | Period    | Th          | 1030 | 1100  | 1325 | Tclk |
|                      | Active    | Tdisp (h)   | 960  |       |      | Tclk |
|                      | Blanking  | Tblk (h)    | 70   | 140   | 368  | Tclk |
| Clock                | Frequency | Fclk=1/Tclk | 50   | 74.25 | 82   | MHz  |
| Vertical Frequency   | Frequency | Fv          | 47   | 60    | 63   | Hz   |
| Horizontal Frequency | Frequency | Fh          | 60   | 67.5  | 73   | KHz  |

Notes:

(1) Display position is specific by the rise of DE signal only.

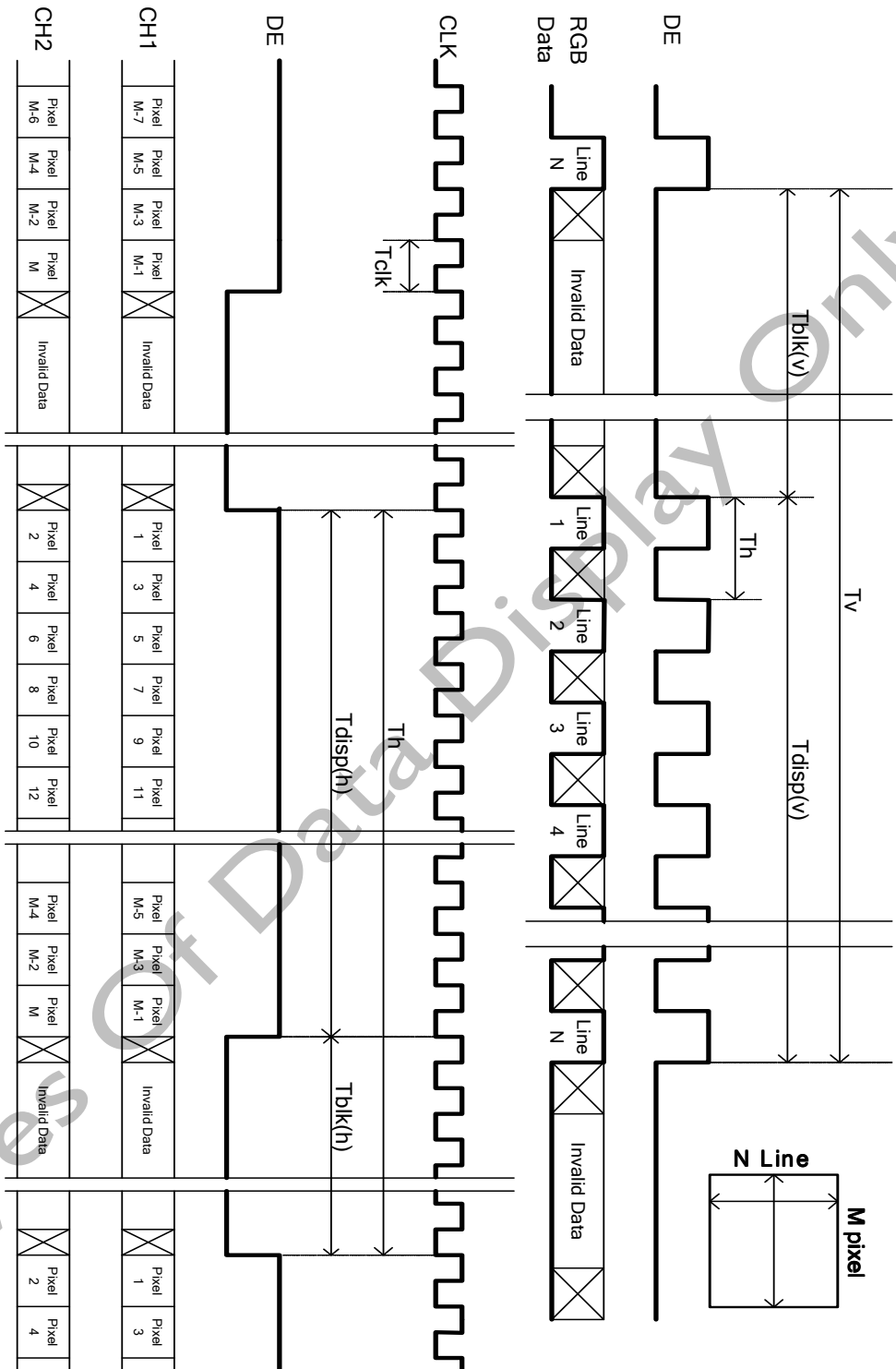
Horizontal display position is specified by the rising edge of 1<sup>st</sup> DCLK after the rise of 1<sup>st</sup> DE, is displayed on the left edge of the screen.

(2) Vertical display position is specified by the rise of DE after a "Low" level period equivalent to eight times of horizontal period. The 1<sup>st</sup> data corresponding to one horizontal line after the rise of 1<sup>st</sup> DE is displayed at the top line of screen.

(3) If a period of DE "High" is less than 1920 DCLK or less than 358 lines, the rest of the screen displays black.

(4) The display position does not fit to the screen if a period of DE "High" and the effective data period do not synchronize with each other.

### 3.4 Signal Timing Waveforms



### 3.5 Color Input Data Reference

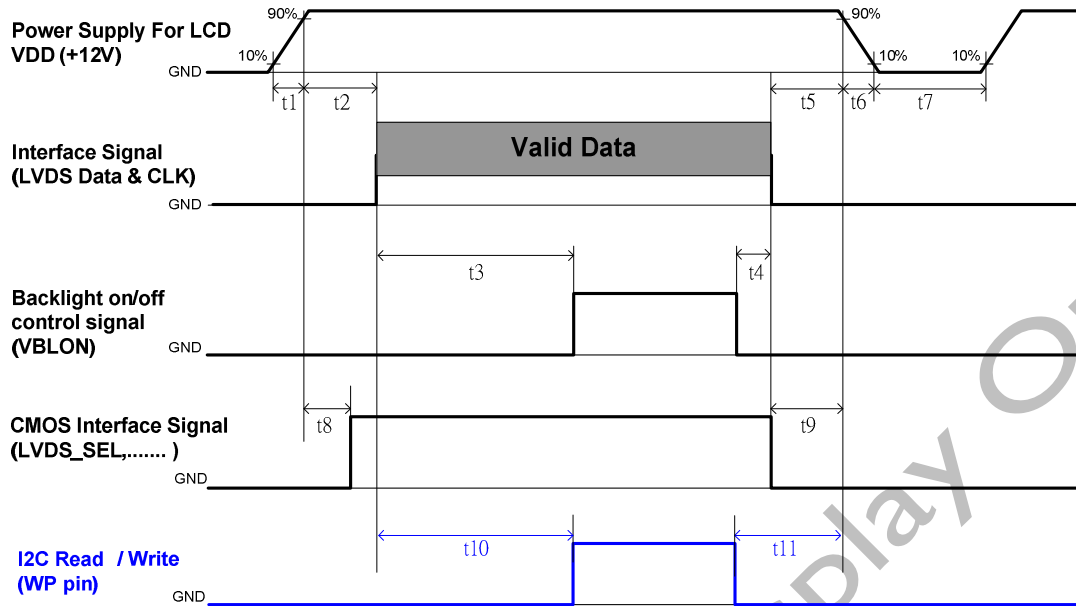
The brightness of each primary color (red, green and blue) is based on the 10 bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

**COLOR DATA REFERENCE**

| Color       |            | Input Color Data |    |    |    |     |    |    |    |       |    |    |    |     |    |    |    |      |    |    |    |     |    |    |    |
|-------------|------------|------------------|----|----|----|-----|----|----|----|-------|----|----|----|-----|----|----|----|------|----|----|----|-----|----|----|----|
|             |            | RED              |    |    |    |     |    |    |    | GREEN |    |    |    |     |    |    |    | BLUE |    |    |    |     |    |    |    |
|             |            | MSB              |    |    |    | LSB |    |    |    | MSB   |    |    |    | LSB |    |    |    | MSB  |    |    |    | LSB |    |    |    |
|             |            | R7               | R6 | R5 | R4 | R3  | R2 | R1 | R0 | G7    | G6 | G5 | G4 | G3  | G2 | G1 | G0 | B7   | B6 | B5 | B4 | B3  | B2 | B1 | B0 |
| Basic Color | Black      | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | Red(255)   | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | Green(255) | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | Blue(255)  | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|             | Cyan       | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|             | Magenta    | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|             | Yellow     | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | White      | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
| R           | RED(000)   | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | RED(001)   | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | ----       |                  |    |    |    |     |    |    |    |       |    |    |    |     |    |    |    |      |    |    |    |     |    |    |    |
|             | RED(254)   | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | RED(255)   | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
| G           | GREEN(000) | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | GREEN(001) | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | ----       |                  |    |    |    |     |    |    |    |       |    |    |    |     |    |    |    |      |    |    |    |     |    |    |    |
|             | GREEN(254) | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | GREEN(255) | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
| B           | BLUE(000)  | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|             | BLUE(001)  | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 1  |
|             | ----       |                  |    |    |    |     |    |    |    |       |    |    |    |     |    |    |    |      |    |    |    |     |    |    |    |
|             | BLUE(254)  | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 0  |
|             | BLUE(255)  | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |

### 3.6 Power Sequence

#### ◆ Power Sequence of LCD



| Parameter | Values           |       |                   | Unit |
|-----------|------------------|-------|-------------------|------|
|           | Min.             | Type. | Max.              |      |
| t1        | 0.4              | ---   | 30                | ms   |
| t2        | 0.1              | ---   | <b>50</b>         | ms   |
| t3        | <b>450</b>       | ---   | ---               | ms   |
| t4        | 0 <sup>*1</sup>  | ---   | ---               | ms   |
| t5        | 0                | ---   | ---               | ms   |
| t6        | ---              | ---   | --- <sup>*2</sup> | ms   |
| t7        | 500              | ---   | ---               | ms   |
| t8        | 10 <sup>*3</sup> | ---   | 50                | ms   |
| t9        | 0                | ---   | ---               | ms   |
| t10       | 450              | ---   | ---               | ms   |
| t11       | 150              | ---   | ---               | ms   |

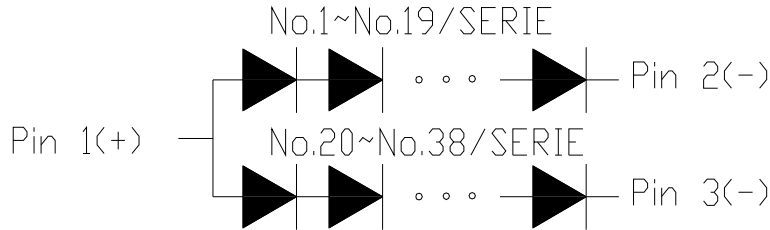
Note:

- (1) t4=0 : concern for residual pattern before BLU turn off.
- (2) t6 : voltage of VDD must decay smoothly after power-off. (customer system decide this value)
- (3) When CMOS Interface signal is N.C. (no connection), opened in Transmitted end, t8 timing spec can be negligible.



### 3.7 Backlight Specification

The backlight unit contains 76pcs LED. It includes two LED light bars and each light bar contains 38pcs LED. (4strings and 19pcs LED of each string)

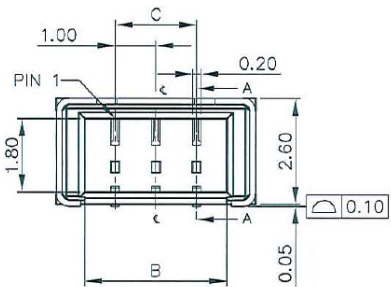


#### 3.7.1 Connector type:

|                            |                        |                     |
|----------------------------|------------------------|---------------------|
| <b>Backlight Connector</b> | Manufacturer           | ENTERYor compatible |
|                            | Connector Model Number | 3707K-S03N-04L      |
| <b>Mating Connector</b>    | Manufacturer           | ENTERYor compatible |
|                            | Connector Model Number | H112K-D03N-20B      |

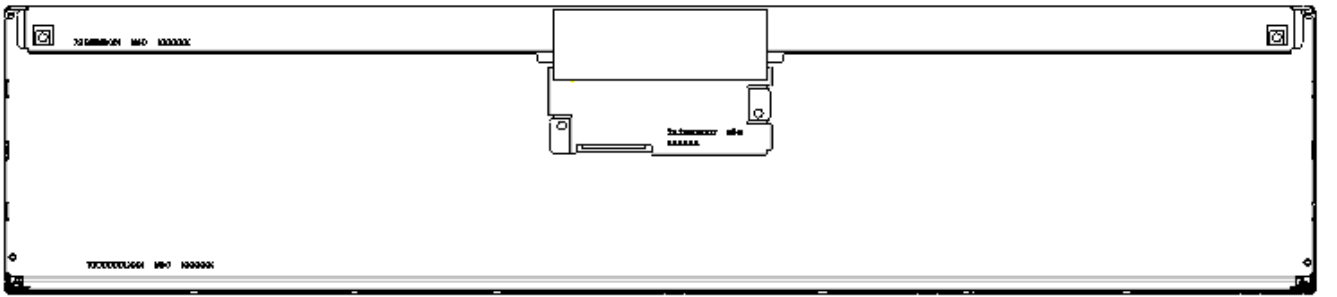
#### 3.7.2 Backlight Connector Dimension

Hx Vx D = 4.9x2.6x4.25 Pitch=1.0 (unit=mm)



#### 3.7.3 Connector Pin Assignment

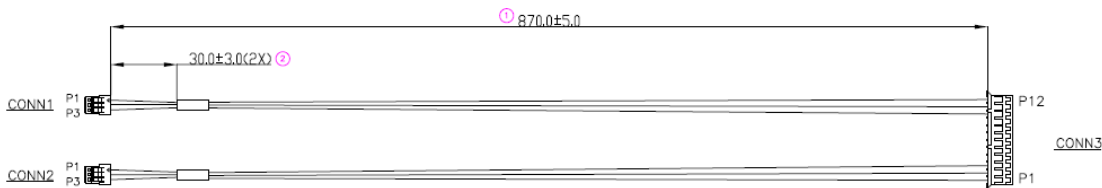
| PIN NO. | SYMBOL | FUNCTION               |
|---------|--------|------------------------|
| 1       | Va(1)  | LED Anode (Positive)   |
| 2       | Vc(1)  | LED Cathode (Negative) |
| 3       | Vc(2)  | LED Cathode (Negative) |



**3.7.3.4 LED Driver Board Connector information**

CN3: Compatible CI0112S0000(Cvilux)

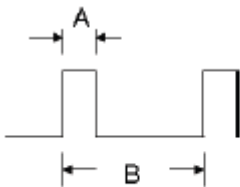
Matching Connector: CI0112M12HR0-NH (Cvilux)



| Pin | Symbol | Description  |
|-----|--------|--------------|
| 1   | VH1    | High Voltage |
| 2   | N.C.   |              |
| 3   | VFB1-1 | Feedback pin |
| 4   | VFB1-1 | Feedback pin |
| 5   | N.C.   |              |
| 6   | N.C.   |              |
| 7   | N.C.   |              |
| 8   | N.C.   |              |
| 9   | VFB1-3 | Feedback pin |
| 10  | VFB1-4 | Feedback pin |
| 11  | N.C.   |              |
| 12  | VH1    | High Voltage |

**3.7.4 Absolute Maximum Rating**

| Symbol | Description        | Min | Max | Unit | Remark                                |
|--------|--------------------|-----|-----|------|---------------------------------------|
| Is     | LED String Current | 0   | 150 | mA   | 100% Duty Ratio                       |
|        |                    |     | 300 | mA   | Duty Ratio ≤ 10%<br>Pulse Time = 10ms |



Duty ratio= ( A / B ) X 100% ; (A: Pulse time, B: Period)

**3.7.5 Recommended Operating Condition**

| Symbol            | Description                               | Min.  | Typ.  | Max. | Unit | Remark                      |
|-------------------|---|-------|-------|------|------|-----------------------------|
| Is                | LED String Current                        | -     | 120   | -    | mA   | 100% Duty ratio of LED Chip |
| Vs                | LED String Voltage                        | 57    | 62.7  | 68.4 | Volt | Note 3-1 and Note 3-5       |
| ΔVs               | Maximum Vs Voltage Deviation of light bar | -     | -     | 1.9  | Volt | Note 3-2                    |
| P <sub>BLU</sub>  | LED Light Bar Power Consumption           | -     | 30.1  | 32.8 | Watt | Note 3-3                    |
| LT <sub>LED</sub> | LED Life Time                             | 50000 | 70000 | -    | Hour | Note 3-4                    |
| OVP               | Over Voltage Protection in system board   | 75.2  | -     | -    | Volt | Note 3-5                    |

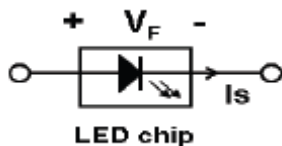
**Note 3-1:**

Vs (Typ.) = VF (Typ.) X LED No. (one string);

a. VF: LED chip forward voltage, VF (Min.)=3.0V, VF(Typ.)=3.3V, VF(Max.)=3.6V

b. The same equation to calculate Vs(Min.) & Vs (Max.) for respective VF (Min.)

& VF(Max.);



**Note 3-2:**

ΔVs (Max.) = ΔVF X LED No. (one string);

a. ΔVF: LED chip forward voltage deviation (0.2V , each Bin of LED VF)

**Note 3-3:**

$PBLU (Typ.) = V_s (Typ.) \times I_s (Typ.) \times 4$  ( 4 is total String No. of BLU )

$PBLU (Max.) = V_s (Max.) \times I_s (Typ.) \times 4$

**Note 3-4:**

Definition of life time:

- a. Brightness of LED becomes to 50% of its original value
- b. Test condition:  $I_s = 120\text{mA}$  and  $25^\circ\text{C}$  (Room Temperature)

**Note 3-5:**

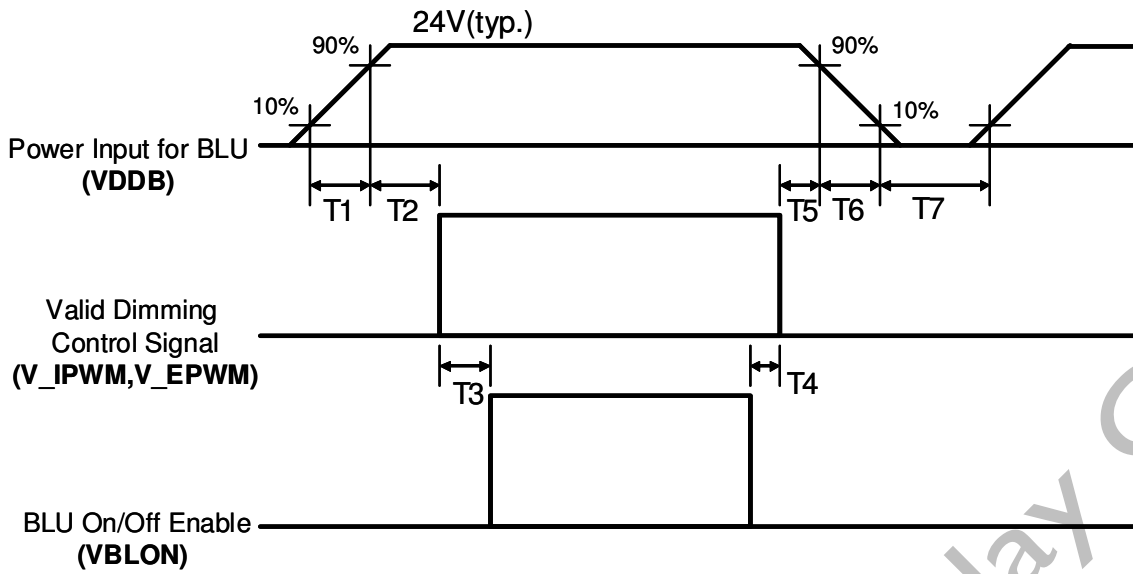
Recommendation for LED driver power design:

Due to there are electrical property deviation in LED & monitor set system component after long time operation. AUO strongly recommend the design value of LED driver board OVP (over voltage protection) should be 10% higher than max. value of LED string voltage ( $V_s$ ) at least.

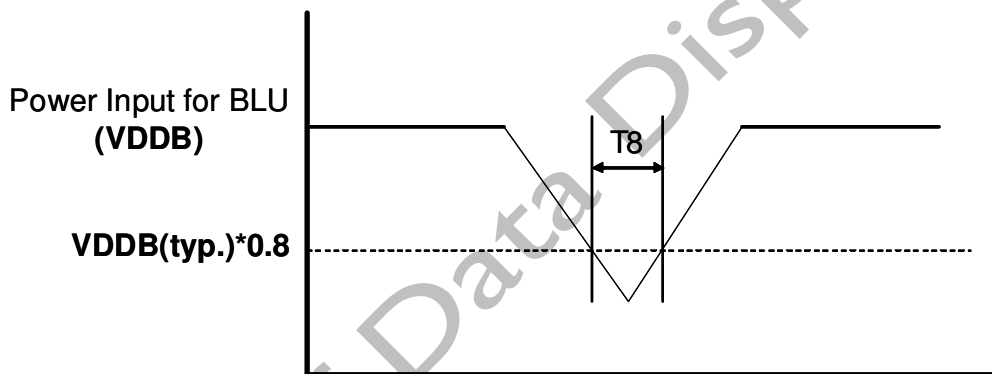
**Note 3-6:**

AUO strongly recommend "Analog Dimming" method for backlight brightness control for Wavy Noise Free. Otherwise, recommend that Dimming Control Signal (PWM Signal) should be synchronized with Frame Frequency

### 3.7.6 Power Sequence for Backlight (LED)



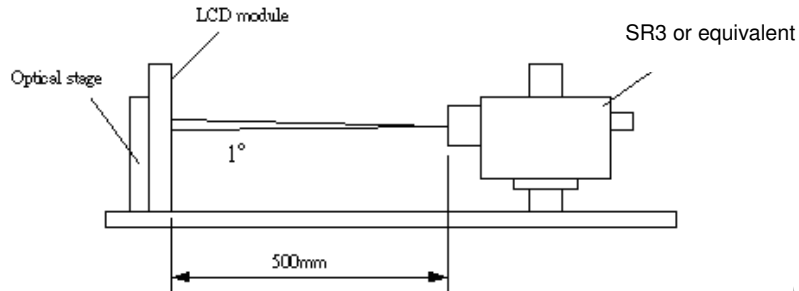
#### Dip condition



| Parameter   | Value |     |     | Units            |
|-------------|-------|-----|-----|------------------|
|             | Min   | Typ | Max |                  |
| T1          | 20    | -   | -   | ms <sup>-1</sup> |
| T2 (Normal) | 500   | -   | -   | ms               |
| T3 (Normal) | 250   | -   | -   | ms               |
| T4          | 0     | -   | -   | ms               |
| T5          | 1     | -   | -   | ms               |
| T6          |       | -   | -   | ms               |
| T8          | -     | -   | 10  | Ms               |

## 4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 45 minutes in a dark environment at 25°C while panel is placed in the default position. The default position is T-con side as the up side of panel. The value specified is at an approximate distance 500mm from the LCD surface at a viewing angle of  $\varphi$  and  $\theta$  equal to 0°.



| Parameter                            | Symbol               | Values    |       |           | Unit              | Notes |
|--------------------------------------|----------------------|-----------|-------|-----------|-------------------|-------|
|                                      |                      | Min.      | Typ.  | Max       |                   |       |
| Contrast Ratio                       | CR                   | 2400      | 3000  | --        |                   | 1     |
| Surface Luminance (White)            | $L_{WH}$             | 560       | 700   | --        | cd/m <sup>2</sup> | 2     |
| Luminance Variation                  | $\delta_{WHITE(9P)}$ | --        | --    | 1.33      |                   | 3     |
| Response Time (G to G)               | $T_{\gamma}$         | --        | 6.5   | 10        | Ms                | 4     |
| Color Gamut                          | NTSC                 | 68        | 72    |           | %                 |       |
| Color Coordinates                    |                      |           |       |           |                   |       |
| Red                                  | $R_x$                | Typ.-0.03 | 0.630 | Typ.+0.03 |                   |       |
|                                      | $R_y$                |           | 0.331 |           |                   |       |
| Green                                | $G_x$                |           | 0.294 |           |                   |       |
|                                      | $G_y$                |           | 0.622 |           |                   |       |
| Blue                                 | $B_x$                |           | 0.151 |           |                   |       |
|                                      | $B_y$                |           | 0.049 |           |                   |       |
| White                                | $W_x$                |           | 0.254 |           |                   |       |
|                                      | $W_y$                |           | 0.276 |           |                   |       |
| Viewing Angle                        |                      |           |       |           |                   |       |
| x axis, right( $\varphi=0^\circ$ )   | $\theta_r$           | --        | 89    | --        | degree            | 5     |
| x axis, left( $\varphi=180^\circ$ )  | $\theta_l$           | --        | 89    | --        | degree            |       |
| y axis, up( $\varphi=90^\circ$ )     | $\theta_u$           | --        | 89    | --        | degree            |       |
| y axis, down ( $\varphi=270^\circ$ ) | $\theta_d$           | --        | 89    | --        | degree            |       |

Note:

1. Contrast Ratio (CR) is defined mathematically as:

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance of } L_{on5}}{\text{Surface Luminance of } L_{off5}}$$

- Surface luminance is luminance value at point 5 across the LCD surface 50cm from the surface with all pixels displaying white. From more information see FIG 2.  $L_{WH} = L_{on5}$  where  $L_{on5}$  is the luminance with all pixels displaying white at center 5 location.
- The variation in surface luminance,  $\delta_{WHITE}$  is defined (center of Screen) as:  

$$\delta_{WHITE(9P)} = \text{Maximum}(L_{on1}, L_{on2}, \dots, L_{on9}) / \text{Minimum}(L_{on1}, L_{on2}, \dots, L_{on9})$$
- Response time  $T_{\gamma}$  is the average time required for display transition by switching the input signal for five luminance ratio (0%,25%,50%,75%,100% brightness matrix) and is based on  $F_v=60\text{Hz}$  to optimize.

| Measured Response Time |      | Target     |             |             |             |             |
|------------------------|------|------------|-------------|-------------|-------------|-------------|
|                        |      | 0%         | 25%         | 50%         | 75%         | 100%        |
| Start                  | 0%   |            | 0% to 25%   | 0% to 50%   | 0% to 75%   | 0% to 100%  |
|                        | 25%  | 25% to 0%  |             | 25% to 50%  | 25% to 75%  | 25% to 100% |
|                        | 50%  | 50% to 0%  | 50% to 25%  |             | 50% to 75%  | 50% to 100% |
|                        | 75%  | 75% to 0%  | 75% to 25%  | 75% to 50%  |             | 75% to 100% |
|                        | 100% | 100% to 0% | 100% to 25% | 100% to 50% | 100% to 75% |             |

- Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG4.

**FIG. 2 Luminance**

Definition of White Variation ( W ):

Measure the luminance of gray level 255 at 3 points

$$W = \text{Maximum} [L (1), L (2), L (3)] / \text{Minimum} [L (1), L (2), L (3)]$$

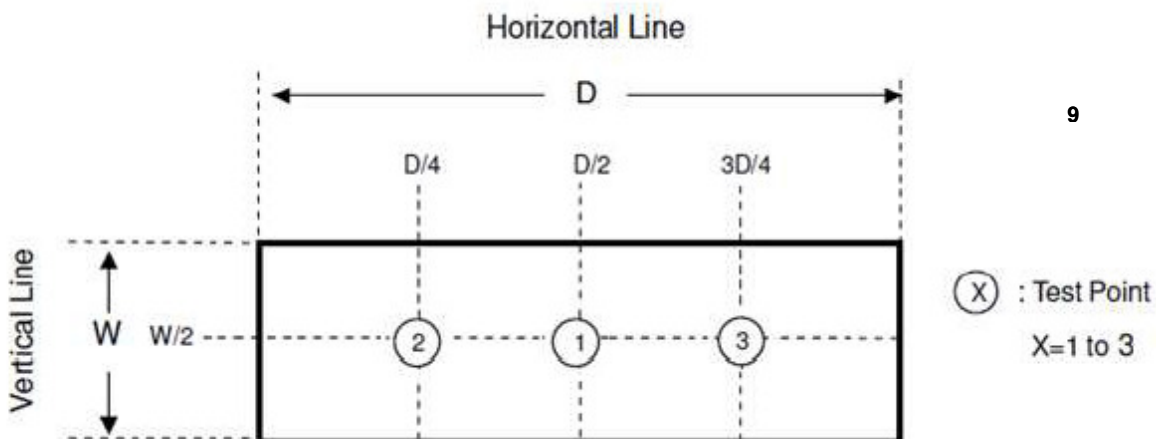
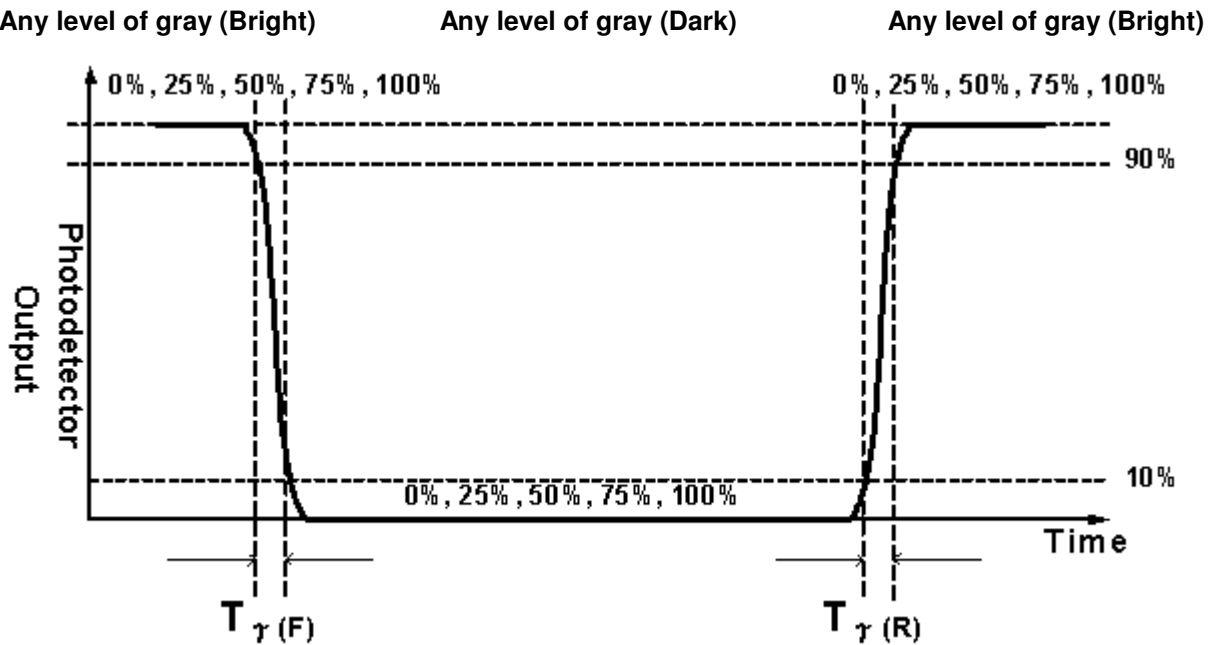
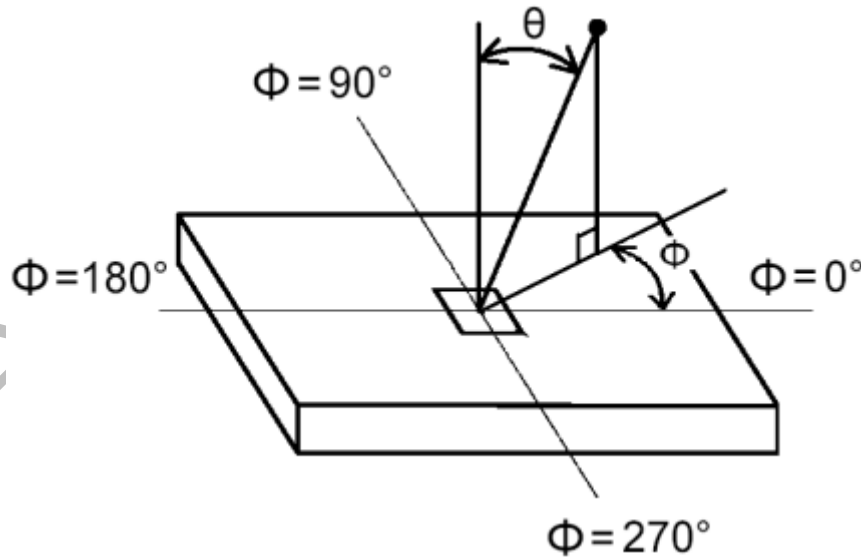


FIG.3 Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for “any level of gray(bright) “ and “any level of gray(dark)”.



6. FIG.4 Viewing Angle





## 5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model P280HVN02.0. In addition the figures in the next page are detailed mechanical drawing of the LCD.

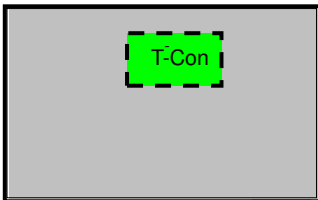
|                     |                   |           |
|---------------------|-------------------|-----------|
| Outline Dimension   | Horizontal (typ.) | 733.78 mm |
|                     | Vertical (typ.)   | 165.43 mm |
|                     | Depth (typ.)      | 17.9 mm   |
| Bezel Opening Area  | Horizontal (typ.) | 702.4 mm  |
|                     | Vertical (typ.)   | 133.86 mm |
| Active Display Area | Horizontal        | 698.4 mm  |
|                     | Vertical          | 129.86 mm |
| Weight              | Typ 1100g         |           |

### 5.1 Placement suggestions:

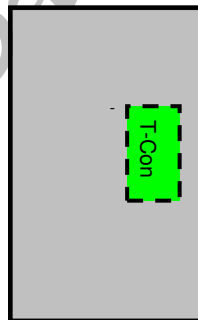
The Suggestion placement is as following:

1. Landscape mode: The default placement is T-Con Side as the top side.
2. Portrait mode: The default placement is T-Con side has to be placed in the right side via viewing from the front.

Landscape (Front view)



Portrait (Front view)





## 6. Reliability Test Items

|   | Test Items                 | Q'ty  | Condition      |
|---|----------------------------|-------|----------------|
| 1 | High Temperature Storage   | 3 pcs | 60°C , 300hrs  |
| 2 | Low Temperature Storage    | 3 pcs | -20°C , 300hrs |
| 3 | High Temperature Operation | 3 pcs | 50°C , 300hrs  |
| 4 | Low Temperature Operation  | 3 pcs | -5°C , 300hrs  |

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## 7. International Standard

### 7.1 Safety

(1) UL60950-1, 2<sup>nd</sup> Ed., Underwriters Laboratories, (AUO file number: E204356)

Standard for safety of information technology equipment including electrical business equipment

(2) IEC 60950-1

(3) EN60950-1

European Committee for Electro technical Standardization (CENELEC)

European Standard for safety of information technology equipment including electrical business equipment

### 7.2 EMC

(1) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz." American National standards Institute(ANSI), 1992

(2) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special committee on Radio Interference.

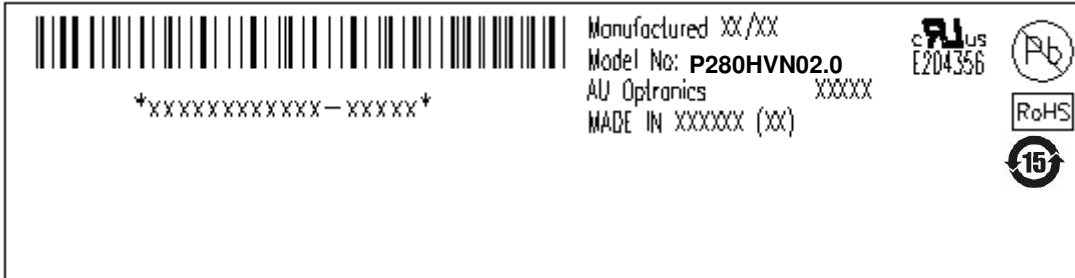
(3) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electro technical Standardization. (CENELEC), 1998

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
## 8. Packing

### 8-1 DEFINITION OF LABEL:

#### A. Panel Label:



#### Green mark description

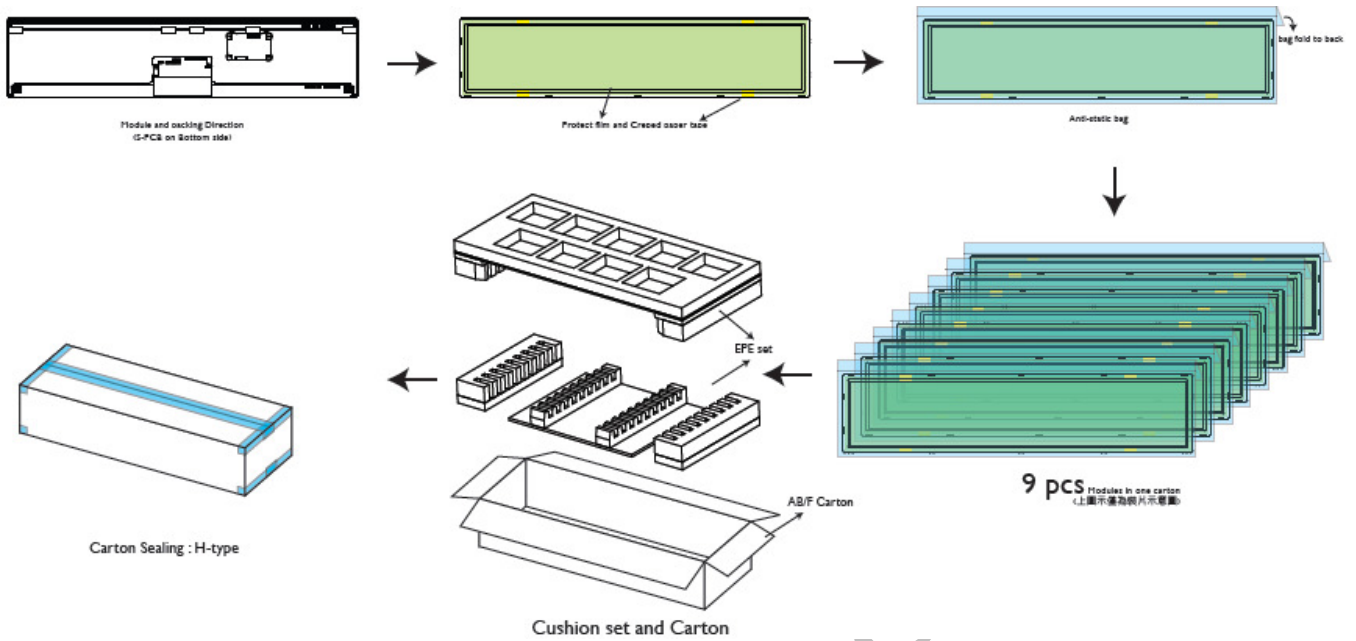
- (1) For Pb Free Product, AUO will add  for identification.
- (2) For RoHS compatible products, AUO will add  for identification.

Note: The green Mark will be present only when the green documents have been ready by AUO internal green team. (definition of green design follows the AUO green design checklist.)

#### B. Carton Label:



**8-2 PACKING METHODS:**



**8-3 Pallet and Shipment Information**

| Item              | Specification    |                       |                   | Packing Remark Qty.  |
|-------------------|------------------|-----------------------|-------------------|--|
|                   | Qty.             | Dimension             | Total Weight (kg) |  |
| Packing BOX       | 9pcs/box         | 832(L)*368(W)*265(H)  | 11.5kg            | 9pcs/box<br>Cushion = 2.5kg<br>(Includes bottom cardboard) |
| Pallet            | 1                | 1150(L)*845(W)*132(H) | Pallet            | 1  |
| Boxes per Pallet  | 24 Boxes /pallet |                       |                   |  |
| Panels per Pallet | 216 pcs /pallet  |                       |                   |  |

## 9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

### 9.1 Mounting Precautions

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. twisted stress) is not applied to module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter cause circuit broken by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizer with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front/ rear polarizer. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

### 9.2 Operating Precautions

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage:  
 $V = \pm 200\text{mV}$  (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer..)
- (3) Brightness depends on the temperature. (In lower temperature, it may become lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interface.

### 9.3 Operating Condition for Public Information Display

The device listed in the product specification is designed and manufactured for PID (Public Information Display) application. To optimize module's lifetime and function, below operating usages are required.

- (1) Normal operating condition
  1. Operating temperature: 5~40°C
  2. Operating humidity: 10~90%
  3. Display pattern: dynamic pattern (Real display).  
Note) Long-term static display would cause image sticking.
- (2) Operation usage to protect against abnormal display due to long-term static display.
  - (1) Suitable operating time: under **20** hours a day.
  - (2) Liquid Crystal refresh time is required. Cycling display between 5 minutes' information (static) display and 10 seconds' moving image.
  - (3) Periodically change background and character (image) color.
  - (4) Avoid combination of background and character with large different luminance.
- (3) Periodically adopt one of the following actions after long time display.
  - A. Running the screen saver (motion picture or black pattern)
  - B. Power off the system for a while
- (4) LCD system is required to place in well-ventilated environment. Adapting active cooling system is highly recommended.
- (5) Product reliability and functions are only guaranteed when the product is used under right operation usages. If product will be used in extreme conditions, such as high temperature/humidity, display stationary patterns, or long operation time etc..., it is strongly recommended to contact AUO for field application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stock market and controlling systems.

### 9.4 Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wristband etc. And don't touch interface pin directly.

### 9.5 Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

### 9.6 Storage

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.



- (2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.
- (3) Storage condition is guaranteed under packing conditions.
- (4) The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition.

### **9.7 Handling Precautions for Protection Film**

- (1) The protection film is attached to the bezel with a small masking tape. When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

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Our company network supports you worldwide with offices in Germany, Austria, Switzerland, the UK and the USA. For more information please contact:

## Headquarters

Germany



**FORTEC Elektronik AG**

Lechwiesenstr. 9  
86899 Landsberg am Lech

Phone: +49 8191 91172-0  
E-Mail: [sales@forteca.de](mailto:sales@forteca.de)  
Internet: [www.forteca.de](http://www.forteca.de)

## Fortec Group Members

Austria



**FORTEC Elektronik AG**

**Office Vienna**

Nuschinggasse 12  
1230 Wien

Phone: +43 1 8673492-0  
E-Mail: [office@fortec.at](mailto:office@fortec.at)  
Internet: [www.fortec.at](http://www.fortec.at)

Germany



**Distec GmbH**

Augsburger Str. 2b  
82110 Germering

Phone: +49 89 894363-0  
E-Mail: [info@distec.de](mailto:info@distec.de)  
Internet: [www.distec.de](http://www.distec.de)

Switzerland



**ALTRAC AG**

Bahnhofstraße 3  
5436 Würenlos

Phone: +41 44 7446111  
E-Mail: [info@altrac.ch](mailto:info@altrac.ch)  
Internet: [www.altrac.ch](http://www.altrac.ch)

United Kingdom



**Display Technology Ltd.**

Osprey House, 1 Osprey Court  
Hichingbrooke Business Park  
Huntingdon, Cambridgeshire, PE29 6FN

Phone: +44 1480 411600  
E-Mail: [info@displaytechnology.co.uk](mailto:info@displaytechnology.co.uk)  
Internet: [www.displaytechnology.co.uk](http://www.displaytechnology.co.uk)

USA



**Apollo Display Technologies, Corp.**

87 Raynor Avenue,  
Unit 1 Ronkonkoma,  
NY 11779

Phone: +1 631 5804360  
E-Mail: [info@apolloDisplays.com](mailto:info@apolloDisplays.com)  
Internet: [www.apolloDisplays.com](http://www.apolloDisplays.com)