

# AZ DISPLAYS

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## SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

| CUSTOMER APPROVAL                                      |  |                 |  |
|--|--|-----------------|--|
|  |  |                 |  |
| ※ PART NO. : <u>ATM1560L1K-CT (AZ DISPLAYS) VER1.1</u> |  |                 |  |
| APPROVAL   |  | COMPANY<br>CHOP |  |
| CUSTOMER<br>COMMENTS                                   |  |                 |  |

| AZ DISPLAYS ENGINEERING APPROVAL |            |             |
|----------------------------------|------------|-------------|
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**REVISION RECORD**

| REVISION | REVISION DATE | PAGE | CONTENTS                   |
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## 1. GENERAL SPECIFICATIONS

ATM1560L1K-CT is a 15.6" TFT Liquid Crystal Display module with LED backlight unit and a 40-pin LVDS interface. It features a tape attached PCAP touch sensor that can be connected via USB or I2C bus. The LCD has a 1920 x 1080 FHD resolutions and is based the an IPS technology supporting 16,194,277 colors.

| Item                            | Specification                           | Remark |
|---------------------------------|---|--------|
| 1. LCD size                     | 15.6 inch(Diagonal)                     |        |
| 2. Driver element               | a-Si TFT active matrix                  |        |
| 3. Resolution                   | 1920 x 1080                             |        |
| 4. Display mode                 | Normally black                          |        |
| 5. Dot Pitch (W*H)              | 0.17925 (H) x 0.17925 (V)               |        |
| 6. Active Area (W*H)            | 344.16 (H) x 193.59 (V)                 |        |
| 7. Module size (W*H)            | 387.73mm(W) x 237.09mm(H) x 12.05 mm(D) | Note 1 |
| 8. Surface treatment            | Glare                                   |        |
| 9. Color arrangement            | RGB-stripe                              |        |
| 10. Interface LCD               | LVDS                                    |        |
| 11. Interface touch             | USB, I2C                                |        |
| 12. Interface Controller        | EXC 80H60                               |        |
| 13. Backlight power consumption | 17.28 W                                 |        |
| 14. Panel power consumption     | 4 W                                     |        |
| 15. Weight                      | 1520 g                                  |        |
| 16. RoHS                        | ROHS compliant                          |        |

**Note 1:** Please refer to mechanical drawing.

## 2.0 MECHANICAL SPECIFICATION

| Item            |                | Min.   | Typ.   | Max.   | Unit |
|-----------------|----------------|--------|--------|--------|------|
| LCD Module Size | Horizontal (H) | 363.3  | 363.8  | 364.3  | mm   |
|                 | Vertical (V)   | 215.4  | 215.9  | 216.4  | mm   |
| Assembly Size   | Horizontal (H) | 387.43 | 387.73 | 388.03 | mm   |
|                 | Vertical (V)   | 236.79 | 237.09 | 237.39 | mm   |
|                 | Thickness (T)  | 11.1   | 12.05  | 13.0   | mm   |

### 3. PIN ASSIGNMENT

#### 3.1 LVDS CONNECTOR

| Pin | Name    | Description  |
|-----|---------|--|
| 1   | LED_Vcc | +12V Vi power supply                                     |
| 2   | LED_Vcc | +12V Vi power supply                                     |
| 3   | LED_Vcc | +12V Vi power supply                                     |
| 4   | LED_Vcc | +12V Vi power supply                                     |
| 5   | GND     | Ground   |
| 6   | GND     | Ground   |
| 7   | GND     | Ground   |
| 8   | GND     | Ground   |
| 9   | LED_EN  | Enable pin   |
| 10  | LED_PWM | Backlight Adjust   |
| 11  | LCD_VCC | LCD logic and driver power 3.3V                          |
| 12  | LCD_VCC | LCD logic and driver power 3.3V                          |
| 13  | LCD_VCC | LCD logic and driver power 3.3V                          |
| 14  | NC      | Not connection, this pin should be open                  |
| 15  | NC      | Not connection, this pin should be open                  |
| 16  | NC      | Not connection, this pin should be open                  |
| 17  | LCD GND | LCD logic and driver ground                              |
| 18  | RXO0-   | Negative LVDS differential data input. Channel O0 (odd)  |
| 19  | RXO0+   | Positive LVDS differential data input. Channel O0 (odd)  |
| 20  | RXO1-   | Negative LVDS differential data input. Channel O1 (odd)  |
| 21  | RXO1+   | Positive LVDS differential data input. Channel O1 (odd)  |
| 22  | RXO2-   | Negative LVDS differential data input. Channel O2 (odd)  |
| 23  | RXO2+   | Positive LVDS differential data input. Channel O2 (odd)  |
| 24  | LCD GND | LCD logic and driver ground                              |
| 25  | RXOC-   | Negative LVDS differential clock input. (odd)            |
| 26  | RXOC+   | Positive LVDS differential clock input. (odd)            |
| 27  | LCD GND | LCD logic and driver ground                              |
| 28  | RXO3-   | Negative LVDS differential data input. Channel O3(odd)   |
| 29  | RXO3+   | Positive LVDS differential data input. Channel O3 (odd)  |
| 30  | RXE0-   | Negative LVDS differential data input. Channel E0 (even) |
| 31  | RXE0+   | Positive LVDS differential data input. Channel E0 (even) |
| 32  | RXE1-   | Negative LVDS differential data input. Channel E1 (even) |
| 33  | RXE1+   | Positive LVDS differential data input. Channel E1 (even) |
| 34  | LCD GND | LCD logic and driver ground                              |
| 35  | RXE2-   | Negative LVDS differential data input. Channel E2 (even) |
| 36  | RXE2+   | Positive LVDS differential data input. Channel E2 (even) |
| 37  | RXEC-   | Negative LVDS differential clock input. (even)           |
| 38  | RXEC+   | Positive LVDS differential clock input. (even)           |
| 39  | RXE3-   | Negative LVDS differential data input. Channel E3 (even) |
| 40  | RXE3+   | Positive LVDS differential data input. Channel E3 (even) |

Note (1) Connector Part No.: I-PEX 20455-040E-76 or equivalent.  
 Note (2) User's connector Part No.: I-PEX 20453-040T-03 or equivalent.

### 3.2 TOUCH PANEL

| Pin No. | Symbol               | Function |
|---------|----------------------|----------|
| 1       | GND                  | Ground   |
| 2       | I <sup>2</sup> C-SDA | SDA      |
| 3       | I <sup>2</sup> C-SCL | SCL      |
| 4       | VDD                  | 5V       |
| 5       | I <sup>2</sup> C-INT | INT      |
| 6       | /RST                 | RESET    |

Connector: E&T (3802K-E06N-01X)

| Pin No. | Symbol    | Function     |
|---------|-----------|--------------|
| 1       | GND-EARTH | GROUND EARTH |
| 2       | VDD       | 5V           |
| 3       | GND       | Ground       |
| 4       | D+        | USB signal + |
| 5       | D-        | USB signal - |

Connector: E&T (3802K-E05N-01X)

## 4. OPERATING SPECIFICATIONS

### 4.1 ABSOLUTE MAXIMUM RATINGS

| Item                  | Symbol          | Values |      | Unit | Remark    |
|-----------------------|-----------------|--------|------|------|-----------|
|                       |                 | Min.   | Max. |      |           |
| Power Voltage         | V <sub>CC</sub> | -0.3   | 3.6  | V    | Note 1    |
| Logic Input Voltage   | V <sub>IN</sub> | -0.3   | 4.0  | V    | Note 1    |
| Operation Temperature | T <sub>OP</sub> | -30    | 80   | °C   |           |
| Storage Temperature   | T <sub>ST</sub> | -40    | 80   | °C   | Note 1, 2 |

**Note 1:** The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

**Note 2:** Temperature and relative humidity range is shown in the figure below.

- (a) 85 %RH Max. (T<sub>a</sub> ≤ 40 °C).
- (b) Wet-bulb temperature should be 39 °C Max. (T<sub>a</sub> > 40 °C).
- (c) No condensation.

#### 4.1.1 Typical Operation Conditions

| Item                            | Symbol           | Values |      |      | Unit | Remark |
|---------------------------------|------------------|--------|------|------|------|--------|
|                                 |                  | Min.   | Typ. | Max. |      |        |
| Power Voltage                   | DV <sub>DD</sub> | 3.15   | 3.3  | 3.6  | V    |        |
|                                 | V <sub>RP</sub>  | -      | -    | 150  | V    |        |
|                                 | I <sub>RP</sub>  | -      | -    | 3    | A    |        |
| POWER CONSUMPTION               | PLCD             | -      | 4    | 5    | Watt |        |
| LVDS differential input voltage | V <sub>id</sub>  | 200    |      | 600  | mV   |        |
| LVDS common input voltage       | V <sub>ic</sub>  | 1.0    | 1.2  | 1.4  | V    |        |
| LVDS terminating resistor       | R <sub>t</sub>   |        | 100  |      | Ohm  |        |

#### 4.1.2 Backlight driving conditions

| Item               | Symbol           | Values |        |      | Unit | Remark  |
|--------------------|------------------|--------|--------|------|------|---------|
|                    |                  | Min.   | Typ.   | Max. |      |         |
| LED String Current | I <sub>s</sub>   | -      | 80     |      | mA   | 1, 2, 6 |
| LED String Voltage | V <sub>s</sub>   |        | 54     |      | V    | 1, 3, 6 |
| Power Consumption  | P <sub>Bar</sub> |        | 17.28  |      | W    | 1, 2, 5 |
| LED Lifetime       | LED_LT           |        | 50,000 |      | Hrs  | 4       |

Notes) The LED Bar consists of 36 LED packages, 4 strings (parallel) x 9 packages (serial)

LED driver design guide:

The design of the LED driver must have specifications for the LED in LCD Assembly.

The performance of the LED in LCM, for example life time or brightness, is extremely influenced by the characteristics of the LED driver.

So all the parameters of an LED driver should be carefully designed and output current should be Constant current control.

Please control feedback current of each string individually to compensate the current variation among the strings of LEDs.

When you design or order the LED driver, please make sure unwanted lighting caused by the mismatch of the LED and the LED driver (no lighting, flicker, etc) never occurs.

When you confirm it, the LCD module should be operated in the same condition as installed in your instrument.

1. The specified values are for a single LED bar.
2. The specified current is defined as the input current for a single LED string with 100% duty cycle.
3. The specified voltage is input LED string and Bar voltage at typical Current 100% duty current. 4. The LED life time is defined as the time when brightness of LED packages become 50% or less than the initial value under the conditions at  $T_a = 25 \pm 2^\circ\text{C}$  and LED string current is typical value.
5. The power consumption shown above does not include loss of external driver. The typical power consumption is calculated as  $P_{Bar} = V_s(\text{Typ.}) \times I_s(\text{Typ.}) \times \text{No. of strings}$ . The maximum power consumption is calculated as  $P_{Bar} = V_s(\text{Max.}) \times I_s(\text{Typ.}) \times \text{No. of strings}$ .
6. LED operating conditions are must not exceed Max. ratings.

4.1.3 LED driver specification

| Item               | Condition                              | Min. | Typ.            | Max. | Unit |
|--------------------|--|------|-----------------|------|------|
| Input Voltage      | -                                      | 11   | 12              | 13.5 | V    |
| Input Current      | $V_{in} = 12.0\text{V}$ ,<br>PWM= 100% | -    | -               | 5    | A    |
| Brightness control | Duty = 100%                            |      | Max. brightness |      | V    |
|                    | Duty = 0.75%                           |      | Min. brightness |      |      |
| PWM                | 100 ~ 20k                              |      | 1k              |      | Hz   |
| Backlight On/Off   | On                                     |      | 2.4 ~ 5.25      |      | V    |
|                    | Off                                    |      | 0 ~ 0.8         |      |      |



4.1.4 Backlight PIN ASSIGNMENT

CN1 INPUT CONNECTOR : 20022WR-06(YEONHO)

| Pin No. | Symbol  | Remarks            |
|---------|---------|--------------------|
| 1       | BRT_ADJ | Brightness Control |
| 2       | ON/OFF  | On/Off Control     |
| 3, 4    | GND     | Ground             |
| 5, 6    | Vin     | DC Input Power     |

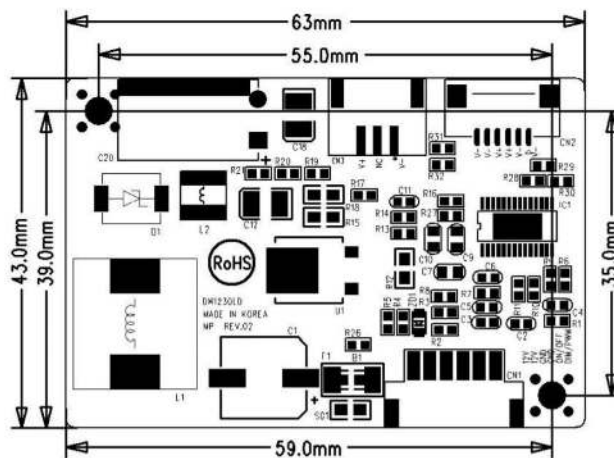
CN3 OUTPUT CONNECTOR : 20037WR-03(YEONHO)

| Pin No. | Symbol | Remarks                  |
|---------|--------|--------------------------|
| 1       | Io     | ILED (current out)       |
| 2       | NC     | Not Connected            |
| 3       | Vin    | VLED (LED Input voltage) |

CN2 OUTPUT CONNECTOR : 12505WR-06(YEONHO)

| Pin No. | Symbol | Remarks                  |
|---------|--------|--------------------------|
| 1       | Io     | ILED (current out)       |
| 2       |        |                          |
| 3       | Vin    | VLED (LED Input voltage) |
| 4       |        |                          |
| 5       | Io     | ILED (current out)       |
| 6       |        |                          |

MECHANICAL DRAWING



#### 4.2 LVDS INPUT SIGNAL SPECIFICATIONS

|                 |             |     |     |     |     |     |     |     |
|-----------------|-------------|-----|-----|-----|-----|-----|-----|-----|
| LVDS Channel O0 | LVDS output | D7  | D6  | D4  | D3  | D2  | D1  | D0  |
|                 | Data order  | OG0 | OR5 | OR4 | OR3 | OR2 | OR1 | OR0 |
| LVDS Channel O1 | LVDS output | D18 | D15 | D14 | D13 | D12 | D9  | D8  |
|                 | Data order  | OB1 | OB0 | OG5 | OG4 | OG3 | OG2 | OG1 |
| LVDS Channel O2 | LVDS output | D26 | D25 | D24 | D22 | D21 | D20 | D19 |
|                 | Data order  | DE  | NA  | NA  | OB5 | OB4 | OB3 | OB2 |
| LVDS Channel O3 | LVDS output | D23 | D17 | D16 | D11 | D10 | D5  | D27 |
|                 | Data order  | NA  | OB7 | OB6 | OG7 | OG6 | OR7 | OR6 |
| LVDS Channel E0 | LVDS output | D7  | D6  | D4  | D3  | D2  | D1  | D0  |
|                 | Data order  | EG0 | ER5 | ER4 | ER3 | ER2 | ER1 | ER0 |
| LVDS Channel E1 | LVDS output | D18 | D15 | D14 | D13 | D12 | D9  | D8  |
|                 | Data order  | EB1 | EB0 | EG5 | EG4 | EG3 | EG2 | EG1 |
| LVDS Channel E2 | LVDS output | D26 | D25 | D24 | D22 | D21 | D20 | D19 |
|                 | Data order  | DE  | NA  | NA  | EB5 | EB4 | EB3 | EB2 |
| LVDS Channel E3 | LVDS output | D23 | D17 | D16 | D11 | D10 | D5  | D27 |
|                 | Data order  | NA  | EB7 | EB6 | EG7 | EG6 | ER7 | ER6 |

### 4.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

| Color               |                | Data Signal |    |    |    |    |    |    |    |       |    |    |    |    |    |    |    |      |    |    |    |    |    |    |    |
|---------------------|----------------|-------------|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|
|                     |                | Red         |    |    |    |    |    |    |    | Green |    |    |    |    |    |    |    | Blue |    |    |    |    |    |    |    |
|                     |                | 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 Colors        | Black          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                     | Red            | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                     | Green          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  |    |
|                     | Blue           | 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  |    |
|                     | Magenta        | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 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  | 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  |    |
| Gray Scale Of Red   | Red(0) / Dark  | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
|                     | Red(1)         | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
|                     | Red(2)         | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
|                     | ⋮              | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  |    |    |    |
|                     | ⋮              | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  |    |    |    |
|                     | Red(253)       | 1           | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 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  |    |    |
|                     | Red(255)       | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
| Gray Scale Of Green | Green(0)/Dark  | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
|                     | Green(1)       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
|                     | Green(2)       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
|                     | ⋮              | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  |    |    |    |
|                     | ⋮              | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  |    |    |    |
|                     | Green(253)     | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 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  |    |    |
|                     | Green(255)     | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
| Gray Scale Of Blue  | Blue(0) / Dark | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |    |    |
|                     | Blue(1)        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 1  |    |    |
|                     | Blue(2)        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 1  |    |    |
|                     | ⋮              | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  |    |    |    |
|                     | ⋮              | ⋮           | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮     | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮  | ⋮    | ⋮  | ⋮  | ⋮  | ⋮  |    |    |    |
|                     | Blue(253)      | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 0  |    |    |
|                     | Blue(254)      | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  |    |    |
|                     | Blue(255)      | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  | 1  |    |    |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

### 4.4 DISPLAY TIMING SPECIFICATIONS

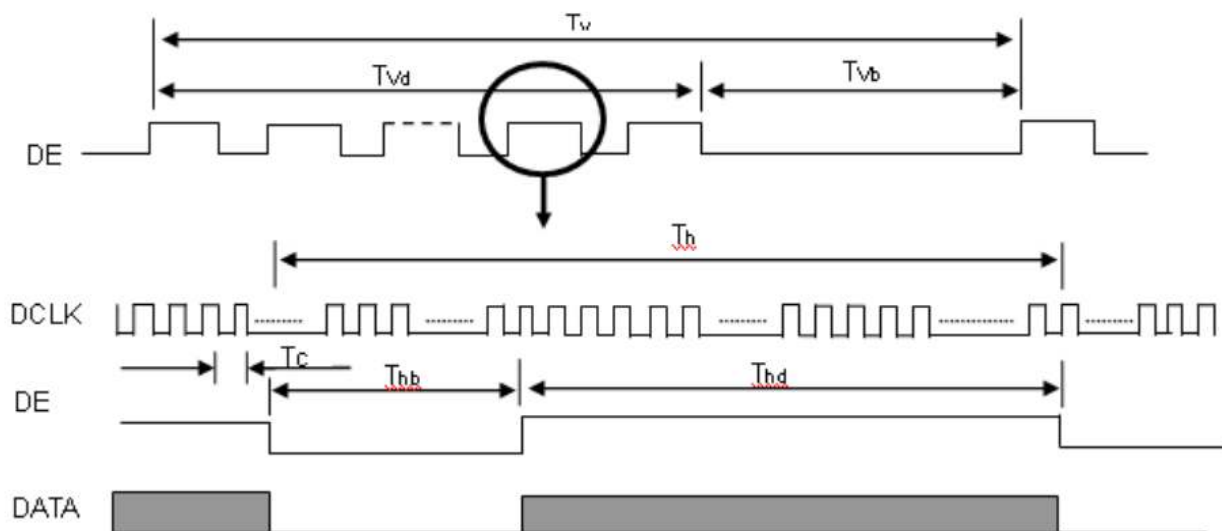
The input signal timing specifications are shown as the following table and timing diagram.

| Signal                  | Item                                 | Symbol                 | Min.                             | Typ.  | Max.                             | Unit           | Note  |
|-------------------------|--------------------------------------|------------------------|----------------------------------|-------|----------------------------------|----------------|---|
| LVDS Clock              | Frequency                            | F <sub>c</sub>         | (60)                             | 70.93 | (75)                             | MHz            | -   |
|                         | Period                               | T <sub>c</sub>         |                                  | 14.1  |                                  | ns             |   |
|                         | Input cycle to cycle jitter          | T <sub>rdl</sub>       | -0.02*T <sub>c</sub>             |       | 0.02*T <sub>c</sub>              | ns             | (3)   |
|                         | Input clock to data skew             | TLVCCS                 | -0.02*T <sub>c</sub>             |       | 0.02*T <sub>c</sub>              | ns             | (4)   |
|                         | Spread spectrum modulation range     | F <sub>clkin_mod</sub> | FC*98%                           |       | FC*102%                          | MHz            | (5)   |
|                         | Spread spectrum modulation frequency | F <sub>SSM</sub>       |                                  |       | 200                              | KHz            |   |
| Vertical Display Term   | Frame Rate                           | Fr                     | (50)                             | 60    | 60                               | Hz             | T <sub>v</sub> =T <sub>v</sub> d+T <sub>v</sub> b |
|                         | Total                                | T <sub>v</sub>         | (1090)                           | 1110  | (1130)                           | Th             | -   |
|                         | Active Display                       | T <sub>v</sub> d       | 1080                             | 1080  | 1080                             | Th             | -   |
|                         | Blank                                | T <sub>v</sub> b       | T <sub>v</sub> -T <sub>v</sub> d | 30    | T <sub>v</sub> -T <sub>v</sub> d | Th             | -   |
| Horizontal Display Term | Total                                | T <sub>h</sub>         | (1050)                           | 1065  | (1075)                           | T <sub>c</sub> | T <sub>h</sub> =T <sub>h</sub> d+T <sub>h</sub> b |
|                         | Active Display                       | T <sub>h</sub> d       | 960                              | 960   | 960                              | T <sub>c</sub> | -   |
|                         | Blank                                | T <sub>h</sub> b       | T <sub>h</sub> -T <sub>h</sub> d | 105   | T <sub>h</sub> -T <sub>h</sub> d | T <sub>c</sub> | -   |

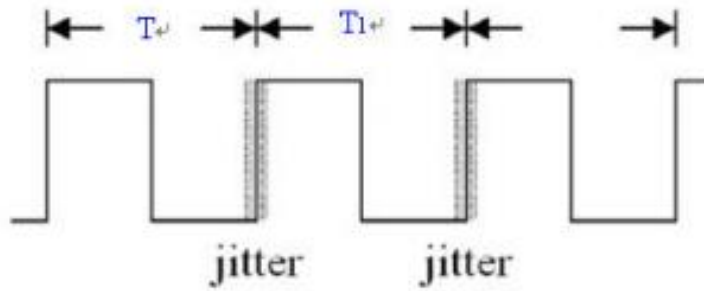
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

Note (2) The T<sub>v</sub>(T<sub>v</sub>d+T<sub>v</sub>b) must be integer, otherwise, this module would operate abnormally.

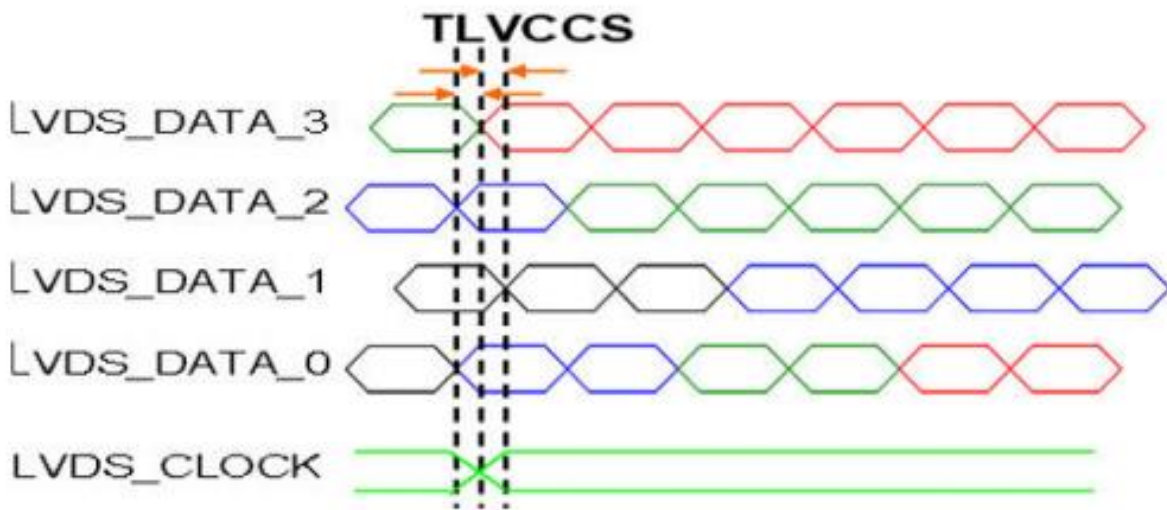
INPUT SIGNAL TIMING DIAGRAM



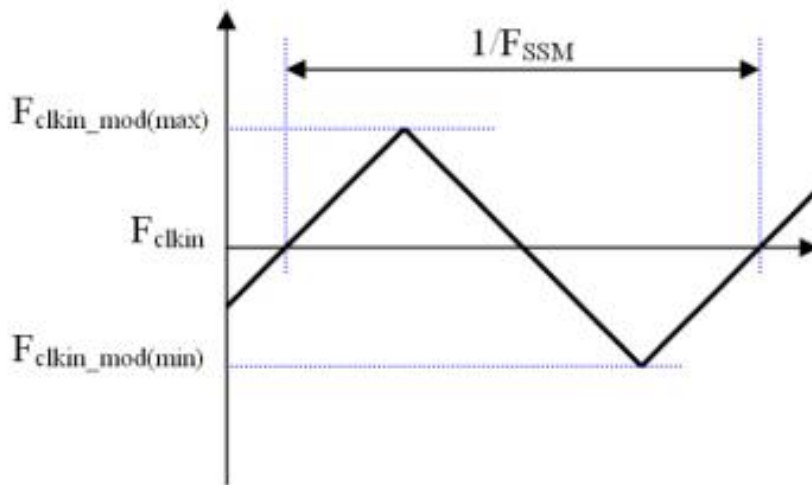
Note (3) The input clock cycle-to-cycle jitter is defined as below figures.  $Trcl = |T_1 - T_1'|$



Note (4) Input Clock to data skew is defined as below figures.

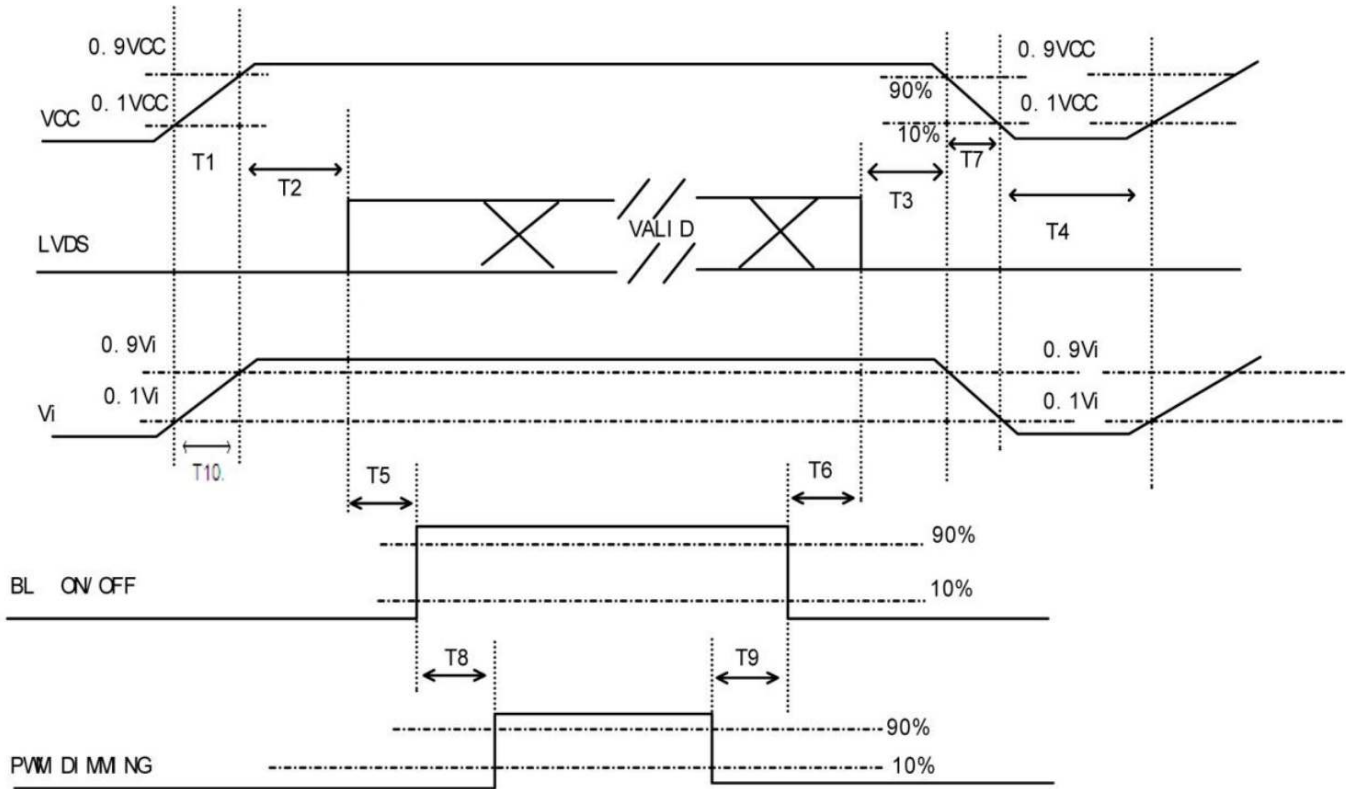


Note (5) The SSCG (Spread spectrum clock generator) is defined as below figures.



### 4.5 POWER ON/OFF SEQUENCE

The power sequence specification are shown as the following table and diagram.



Timing Specifications:

| Parameter | Value |     |     | Units |
|-----------|-------|-----|-----|-------|
|           | Min   | Typ | Max |       |
| T1        | 0.5   | -   | 10  | ms    |
| T2        | 0     | -   | 50  | ms    |
| T3        | 0     | -   | 50  | ms    |
| T4        | 500   | -   | -   | ms    |
| T5        | 450   | -   | -   | ms    |
| T6        | 20    | -   | -   | ms    |
| T7        | 10    | -   | 300 | ms    |
| T8        | 10    | -   | -   | ms    |
| T9        | 10    | -   | -   | ms    |
| T10       | 20    | -   | -   | ms    |

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

## 5.0 OPTICAL SPECIFICATIONS

### 5.1 TEST CONDITIONS

| Item                                      | Symbol   | Value | Unit |
|---|--|-------|------|
| Ambient Temperature                       | Ta   | 25±2  | °C   |
| Ambient Humidity                          | Ha   | 50±10 | %RH  |
| Supply Voltage                            | According to typical value in "ELECTRICAL CHARACTERISTICS" |       |      |
| Input Signal                              |  |       |      |
| LED Light Bar Input Current Per Input Pin |  |       |      |

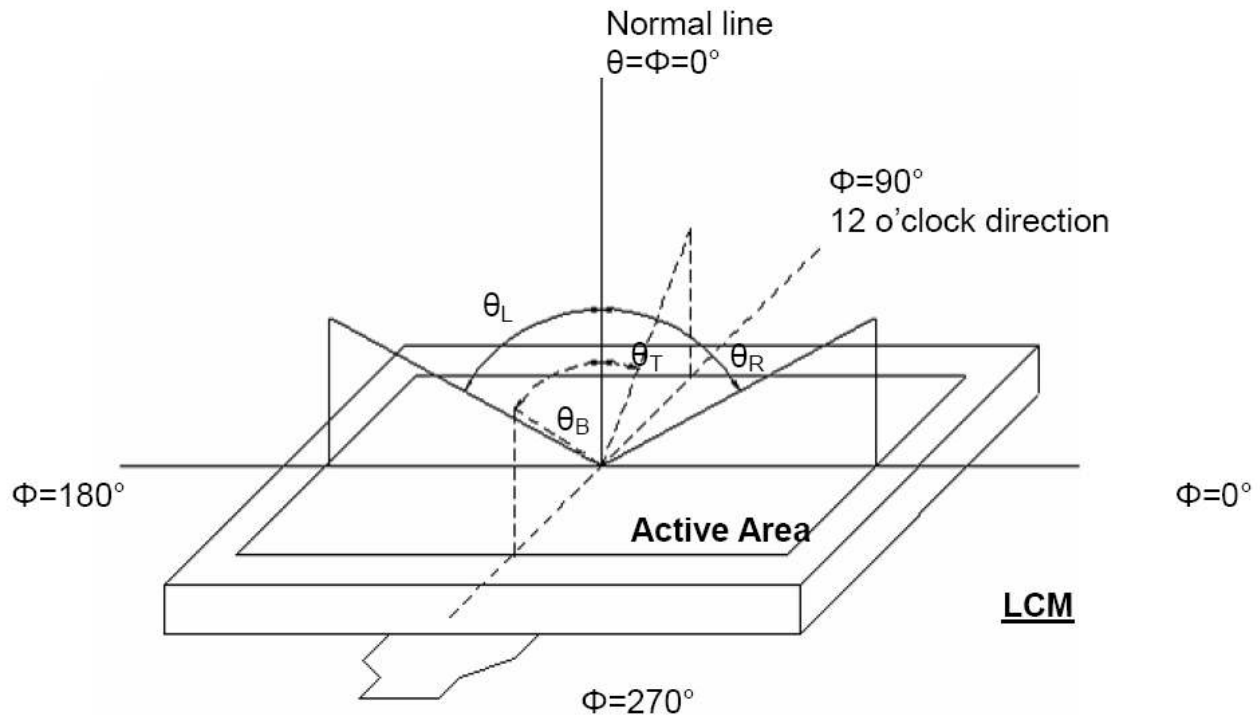
### 5.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 5.2 and all items are measured at the center point of screen except white variation. The following items should be measured under the test conditions described in 5.1 and stable environment shown in Note (5).

| Item                              | Symbol           | Condition         | Values |      |      | Unit              | Remark           |
|-----------------------------------|------------------|-------------------|--------|------|------|-------------------|------------------|
|                                   |                  |                   | Min.   | Typ. | Max. |                   |                  |
| <b>Viewing Angle</b><br>(CR ≥ 10) | θ <sub>L</sub>   | Φ=180°(9 O'CLOCK) | 80     | 85   | --   | degree            | Note 1, 5        |
|                                   | θ <sub>R</sub>   | Φ=0°(3 O'CLOCK)   | 80     | 85   | --   |                   |                  |
|                                   | θ <sub>T</sub>   | Φ=90°(12 O'CLOCK) | 80     | 85   | --   |                   |                  |
|                                   | θ <sub>B</sub>   | Φ=270°(6 O'CLOCK) | 80     | 85   | --   |                   |                  |
| <b>Response Time</b>              | T <sub>ON</sub>  | Normal<br>Θ=Φ=0°  | --     | 12   | 17   | msec              | Note 3           |
|                                   | T <sub>OFF</sub> |                   | --     | 13   | 18   | msec              | Note 3           |
| <b>Contrast Ratio</b>             | CR               |                   | 4000   | 5000 | --   | --                | Note 2,5         |
| <b>Color Chromaticity</b>         | W <sub>X</sub>   |                   | 0.26   | 0.31 | 0.36 | --                | Note 2           |
|                                   | W <sub>Y</sub>   |                   | 0.28   | 0.33 | 0.38 | --                | Note 5<br>Note 6 |
| <b>Luminance center</b>           | L                |                   | 1200   | 1350 | --   | cd/m <sup>2</sup> | Note 4, 5        |
| <b>Luminance Uniformity</b>       | YU               |                   | 70     | -    | --   | %                 | Note 5, 6        |



**Note 1:** Definition of viewing angle range



**Note 2:** Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

L<sub>255</sub>: Luminance of gray level 255

L<sub>0</sub>: Luminance of gray level 0

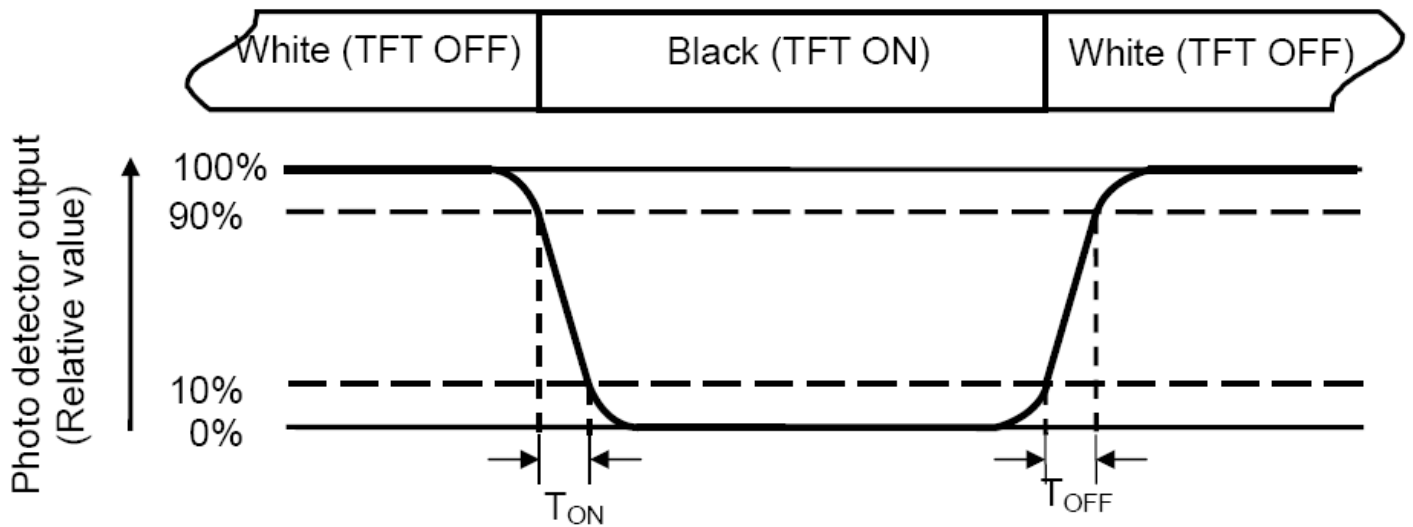
$$\text{CR} = \text{CR} (X)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

**Note 3:** Definition of Response time

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





**Note 4:** Definition of Luminance of White (LC):

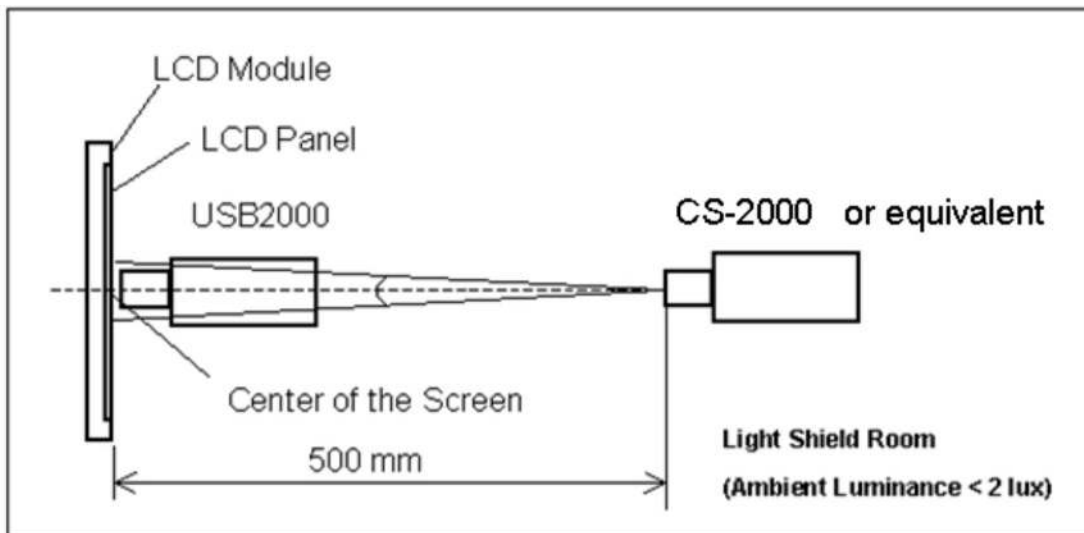
Measure the luminance of gray level 255 at center point

$$LC = L(5)$$

$L(x)$  is corresponding to the luminance of the point X at Figure in Note (6).

**Note 5:** Measurement Setup:

The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a windless room.

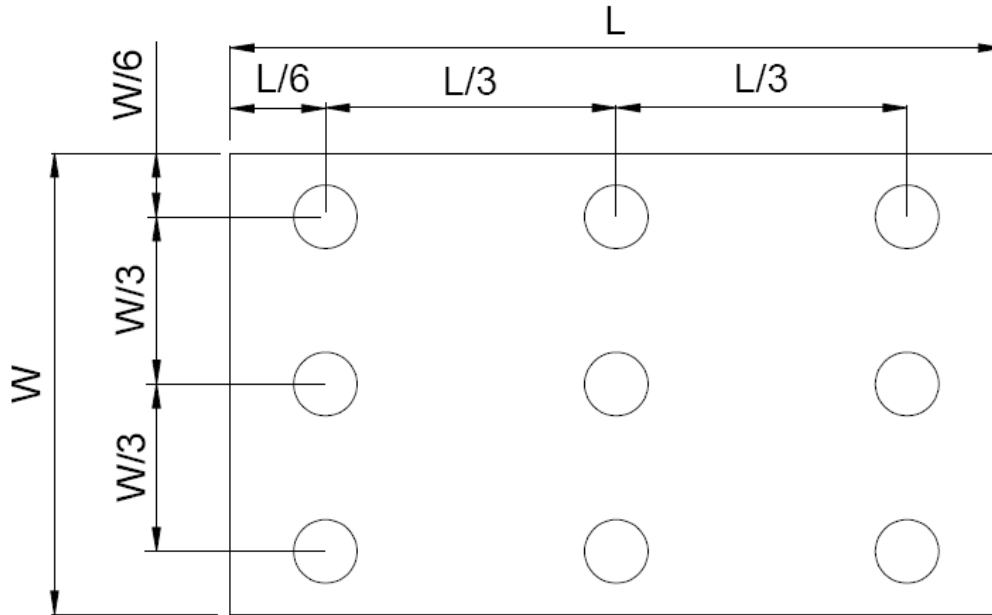


**Note 6:** Definition of White Variation ( $\delta W$ ):

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

$$\text{Luminance Uniformity (Yu)} = \frac{B_{min}}{B_{max}}$$

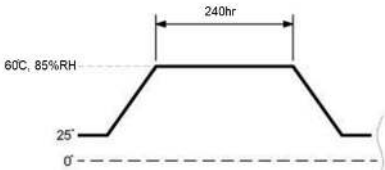
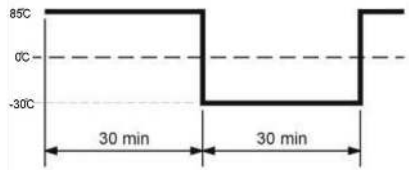
L-----Active area length      W----- Active area width



BMAX: THE MEASURED MAXIMUM LUMINANCE OF ALL MEASUREMENT POSITION.

BMIN: THE MEASURED MINIMUM LUMINANCE OF ALL MEASUREMENT POSITION.

**6. RELIABILITY TEST**

| Item  | Symbol   | Condition   |
|---|--|---|
| (1)<br><b>Constant Temperature / Humidity</b> | 60°C, 85%RH for 240 hours<br>   | (1), (2), (4), (6)                                      |
| (2)<br><b>High Temperature Storage Test</b>   | 85°C for 240 hours   | (1), (2), (4), (5)                                      |
| (3)<br><b>Low Temperature Storage Test</b>    | -40°C for 240 hours  |   |
| (4)<br><b>High Temperature Storage Test</b>   | 80°C for 240 hours   |   |
| (5)<br><b>Low Temperature Storage Test</b>    | -30°C for 240 hours  |   |
| (6)<br><b>Thermal Cycle Test</b>              | -30°C ~ 85°C, 1 hour cycles, 100 cycles<br>  |   |
| (7)<br><b>Daylight Exposure</b>               | UV Sensor: 340nm<br>UV Filter: Daylight-Q or B/B<br>Black Panel: Insulated<br>Applicable Models:<br>Xe-3-HS/HSC/HDS/HBS<br>50%RH, 0.51w/m2 Irrad, 65°C BP<br>temp, 38°C Air temp, Duration 1,000 hours | Comply with ISO 4892-2 Cycle 1 (Spray test is Excluded) |

Note (1) There should be no condensation on the surface of panel during test.

Note (2) Temperature of panel display surface area should be 90 °C Max.

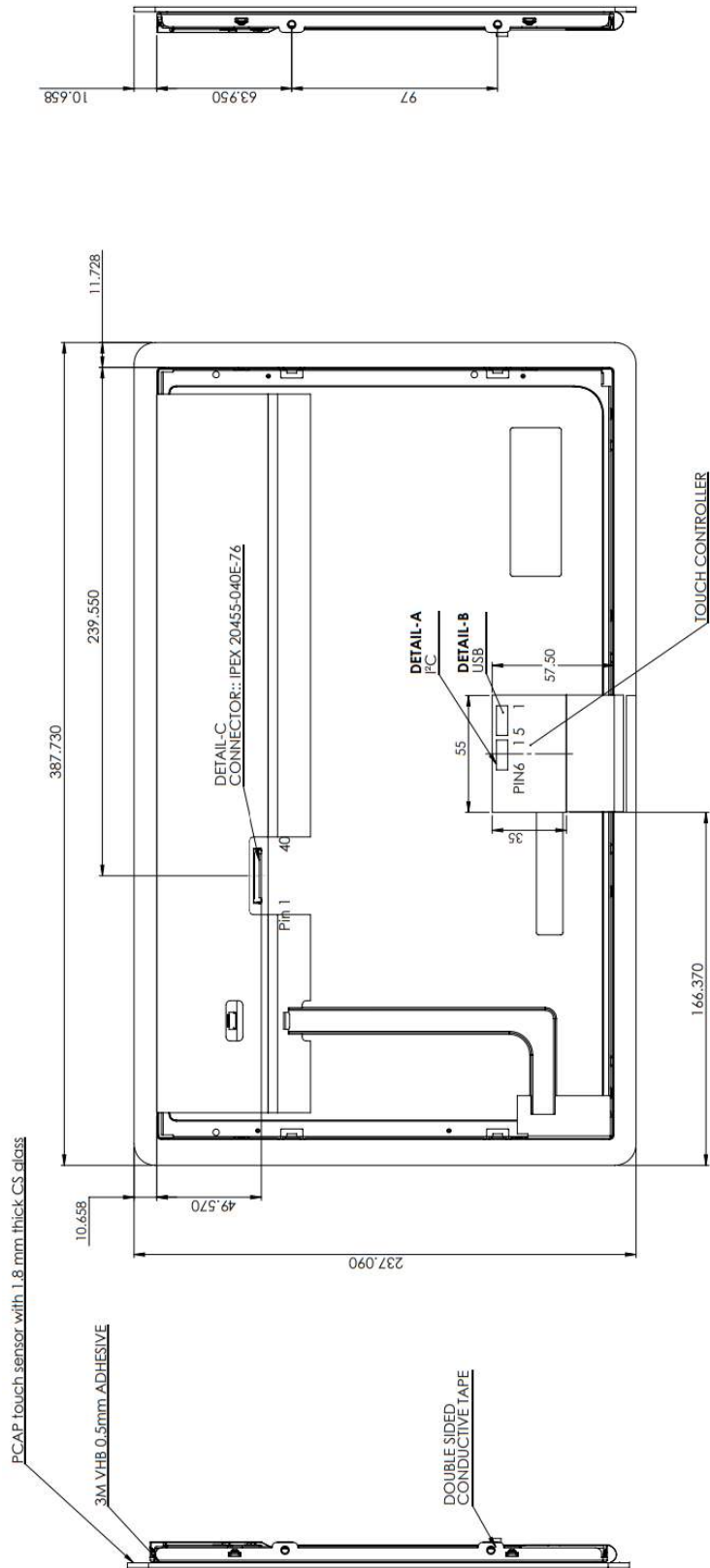
Note (3) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

Note (4) In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before reliability test.

Note (5) Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note (6) Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

7. MECHANICAL DRAWINGS



## 8. PRECAUTIONS

### 8.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.
- (4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull the I/F connector in or out while the module is operating.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
- (9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly.

### 8.2 STORAGE PRECAUTIONS

- (1) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0°C to 35°C and relative humidity of less than 70%
- (2) Do not store the TFT – LCD module in direct sunlight
- (3) The module should be stored in dark place. It is prohibited to apply sunlight or fluorescent light in storing

### 8.3 OPERATION PRECAUTIONS

- (1) The LCD product should be operated under normal condition. Normal condition is defined as below :  
Temperature : 20±15°C Humidity: 65±20% Display pattern : continually changing pattern(Not stationary)
- (2) If the product will be used in extreme conditions such as high temperature, high humidity, high altitude ,display pattern or operation time etc...It is strongly recommended to contact AZD for application engineering advice . Otherwise , Its reliability and function may not be guaranteed.

### 8.4 SAFETY PRECAUTIONS

- (1) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (2) After the module's end of life, it is not harmful in case of normal operation and storage.

### 8.5 SAFETY STANDARDS

The LCD module should be certified with safety regulations as follows:

- (1) UL60950-1 or updated standard.
- (2) IEC60950-1 or updated standard.

### 8.6 OTHER

When fixed patterns are displayed for a long time, remnant image is likely to occur

## 9. INSPECTION SPECIFICATION

### 1. SCOPE SPECIFICATIONS CONTAIN

- 1.1 DISPLAY QUALITY EVALUATION
- 1.2 MECHANICS SPECIFICATION

### 2. SAMPLING PLAN

UNLESS THERE IS OTHER AGREEMENT, THE SAMPLING PLAN FOR INCOMING INSPECTION SHALL FOLLOW MIL-STD-105E.

- 2.1 LOT SIZE: QUANTITY PER SHIPMENT AS ONE LOT (DIFFERENT MODEL AS DIFFERENT LOT ).
- 2.2 SAMPLING TYPE: NORMAL INSPECTION, SINGLE SAMPLING.
- 2.3 SAMPLING LEVEL: LEVEL II.
- 2.4 AQL: ACCEPTABLE QUALITY LEVEL  
 MAJOR DEFECT: AQL=0.65  
 MINOR DEFECT: AQL=1.0

### 3. PANEL INSPECTION CONDITION

- 3.1 ENVIRONMENT:  
 ROOM TEMPERATURE: 25±5°C.  
 HUMIDITY: 65±5% RH.  
 ILLUMINATION: 300 ~ 700 LUX.
- 3.2 INSPECTION DISTANCE:  
 35±5 CM
- 3.3 INSPECTION ANGLE:  
 THE VISION OF INSPECTOR SHOULD BE PERPENDICULAR TO THE SURFACE OF THE MODULE.
- 3.4 INSPECTION TIME:  
 PERCEPTIBILITY TEST TIME: 20 SECONDS MAX.

### 4. DISPLAY QUALITY

- 4.1 FUNCTION RELATED:  
 THE FUNCTION DEFECTS OF LINE DEFECT, ABNORMAL DISPLAY, AND NO DISPLAY ARE CONSIDERED MAJOR DEFECTS.
- 4.2 BRIGHT/DARK DOTS:

| Defect Type                | Specification | Major | Minor |
|----------------------------|---------------|-------|-------|
| Bright Dots                | $N \leq 2$    |       | ●     |
| Dark Dots                  | $N \leq 3$    |       | ●     |
| Total Bright and Dark Dots | $N \leq 4$    |       | ●     |

Note 1:

The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.

Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

The bright dot defect must be visible through 2% ND filter

Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.

4.3 Pixel Definition:

|   |   |   |   |   |   |   |   |   |  |                     |
|---|---|---|---|---|---|---|---|---|--|---------------------|
| R | G | B | R | G | B | R | G | B |  | Dot Defect          |
| R | G | B | R | G | B | R | G | B |  | Adjacent Dot Defect |
| R | G | B | R | G | B | R | G | B |  | Cluster             |

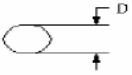
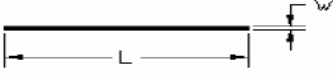
Note 1:

If pixel or partial sub-pixel defects exceed 50% of the affected pixel or sub-pixel area, it shall be considered as 1 defect.

Note 2:

There should be no distinct non-uniformity visible through 2% ND Filter within 2 sec inspection times.

4.4 Visual Inspection specifications:

| <u>Defect Type</u>  |                   | <u>Specification Size</u>   | <u>Count(N)</u> | Major | Minor |   |
|---|-------------------|---|-----------------|-------|-------|---|
| Dot Shape<br>(Particle · Scratch and Bubbles in display area)<br>            |                   | $D \leq 0.25 \text{ mm}$  | Ignored         |       | •     |   |
|   |                   | $0.25\text{mm} < D \leq 0.5\text{mm}$                             | $N \leq 3$      |       |       |   |
|   |                   | $D > 0.5\text{mm}$  | $N=0$           |       |       |   |
| Newton Ring (Only for Touch panel)  |                   | $D \leq 70\text{mm}$  | $N \leq 4$      |       | •     |   |
|   |                   | $D > 70\text{mm}$   | $N=0$           |       |       |   |
| TSP Fish Eyes (Only for Touch panel)<br>(Bubble/Dent)   |                   | $0.1\text{mm} < D \leq 0.2\text{mm}$                              | $N \leq 4$      |       | •     |   |
|   |                   | $0.2\text{mm} < D \leq 0.3\text{mm}$                              | $N \leq 3$      |       |       |   |
|   |                   | $0.3 < D \leq 0.4$  | $N \leq 2$      |       |       |   |
| Line Shape<br>(Particles · Scratch · Lint and Bubbles in display area)<br> |                   | $W \leq 0.01 \text{ mm}$  | Ignored         |       | •     |   |
|   |                   | $0.01\text{mm} < W \leq 0.05\text{mm}$<br>and $L \leq 3\text{mm}$ | $N \leq 3$      |       |       |   |
|   |                   | $W > 0.05\text{mm}$ or $L > 3 \text{ mm}$                         | $N=0$           |       |       |   |
| Bubble in cell (active area)  |                   | It should be found by eyes  |                 |       | •     |   |
| Bezel   | Scratch           | No harm   |                 |       | •     |   |
|   | Dirt              |   |                 |       | •     |   |
|   | Wrap              |   |                 |       | •     |   |
|   | Sunken            |   |                 |       | •     |   |
| Label   | No label          |   |                 |       | •     |   |
|   | Inverted label    |   |                 | No    |       | • |
|   | Broken            |   |                 |       |       | • |
|   | Dirt              | Word can be read.   |                 |       | •     |   |
|   | Not clear         | No  |                 |       | •     |   |
|   | Word out of shape |   |                 |       | •     |   |
|   | Mistake           | No  |                 | •     |       |   |
|   | Position          | Be attached on right position                                     |                 |       | •     |   |
| Screw   | Not enough        | No  |                 |       | •     |   |
|   | Limp              | No  |                 |       | •     |   |



|           |                   |                            |  |   |
|-----------|-------------------|----------------------------|--|---|
| Connector | Connection status | No bend on pins and damage |  | • |
| FPC/FFC   | Broken            | No                         |  | • |

Note: Extraneous substance and scratch not affecting the display of image, for instance, extraneous substance under polarizer film but outside the display area, or scratch on metal bezel and backlight module or polarizer film outside the display area, shall not be considered as defective or non-conforming.

## 10. PACKING

### 10.1 PACKING SPECIFICATIONS

- (1) 18 pcs LCD modules / 1 Box
- (2) Box dimensions: 465 (L) X 362 (W) X 314 (H) mm
- (3) Weight: approximately 29 Kg (18 modules per box)

- (1) Carton dimensions : 465(L)x362(W)x314(H)mm
- (2) 18 Modules/Carton

