

# KOE

## JDI Group

Kaohsiung Opto-Electronics Inc.

FOR MESSRS : \_\_\_\_\_

DATE: Oct. 25<sup>th</sup>, 2019

### CUSTOMER'S ACCEPTANCE SPECIFICATIONS

### TX11D201VM0BAA

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ACCEPTED BY: \_\_\_\_\_

PROPOSED BY: Oblack Tsai

## 2. RECORD OF REVISION

| DATE       | SHEET No.                                     | SUMMARY   |
|------------|---|---|
| Oct.25,'19 | 7B64PS2704-<br>TX11D201VM0BAA-2<br>Page 4-1/1 | <b>4. ABSOLUTE MAXIMUM RATINGS</b><br>Revised : Operating temperature (panel surface) Min. -30<br>↓<br>Operating temperature (ambient temperature) Min. -40 |
|            | 7B64PS2708-<br>TX11D201VM0BAA-2<br>Page 8-1/1 | <b>8. RELIABILITY TESTS</b><br>Revised : Low temperature Operating -30 deg.C, 500Hr<br>↓<br>Low temperature Operating -40 deg.C, 500Hr                      |
|            |   |   |

### 3. GENERAL DATA

#### 3.1 DISPLAY FEATURES

This module is a 4.2" WQVGA of 16:9 format amorphous silicon TFT. The pixel format is vertical stripe and sub pixels are arranged as R(red), G(green), B(blue) sequentially. This display is RoHS compliant, COG (chip on glass) technology and LED backlight are applied on this display.

|                         |  |
|-------------------------|--|
| Part Name               | TX11D201VM0BAA                           |
| Module Dimensions       | 102.5(W) mm x 69.0(H) mm x 9.8 (D) mm    |
| LCD Active Area         | 92.88(W) mm x 52.632(H) mm               |
| Pixel Pitch             | 0.0645 x3(RGB) (W)mm x0.1935 (H) mm      |
| Resolution              | 480x3(RGB)(W) x 272(H) dots              |
| Color Pixel Arrangement | R, G, B Vertical stripe                  |
| LCD Type                | Transmissive Color TFT; Normally Black   |
| Polarizer surface       | Antiglare / Antireflection, Hardness: 2H |
| Display Type            | Active Matrix                            |
| Number of Colors        | 16.7M Colors (8-bit RGB)                 |
| Backlight               | Light Emitting Diode(LED)                |
| Weight                  | 97g (typ.)                               |
| Interface               | CMOS; 68 pins                            |
| Power Supply Voltage    | 3.3V for LCD; 13.5V for backlight.       |
| Viewing Direction       | Super Wide Version (In Plane Switching)  |

## 4. ABSOLUTE MAXIMUM RATINGS

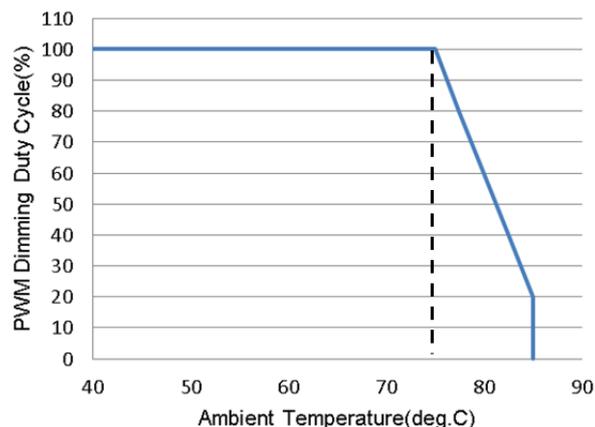
| Item  | Symbol | Min. | Max.    | Unit  | Remarks                    |
|---|--------|------|---------|-------|----------------------------|
| Input voltage                               | VB+    | -0.3 | 23      | V     | -                          |
| +3.3V power supply voltage                  | VCC    | -0.3 | 4.0     | V     | -                          |
| Input signal voltage 1                      | Vi1    | -0.3 | 7.0     | V     | Note 1, 4                  |
| Input signal voltage 2                      | Vi2    | -0.3 | VCC+0.3 | V     | Note 2                     |
| Operating temperature (ambient temperature) | TOP    | -40  | 85      | deg.C | No dew condition<br>Note 3 |
| Storage Temperature                         | TST    | -40  | 95      |       |                            |

Note 1: BL\_PWM

Note 2: HD, DEN, VD, NCLK, R0-R7, G0-G7, B0-B7, HRV, VRV, PON

Note 3: Module temperature is apt to increase while it's driving due to the heat of backlight etc. Design carefully not to exceed +85deg.C at every point of LCD surface that should come to contact with any other equipment. In operation temperature range, only LCD operation is assured. Contrast, response time, or other LCD characteristics are specified in the condition of ambient temperature: Ta=+25deg.C.

Note 4: PWM dimming shall operate at  $T_a \geq 75\text{deg.C}$  (See the following figure)



Ambient Temperature vs. PWM Dimming Duty Cycle  
(Reference data as LCD module alone)

## 5. ELECTRICAL CHARACTERISTICS

### 5.1 LCD CHARACTERISTICS

$T_a = 25\text{ }^\circ\text{C}$ ,  $V_{SS} = 0\text{V}$

| Item                      | Symbol      | Condition        | Min.   | Typ. | Max.  | Unit  | Remarks |
|---------------------------|-------------|------------------|--------|------|-------|-------|---------|
| Power Supply Voltage      | VCC         | -                | 3.0    | 3.3  | 3.6   | V     | -       |
| Permissive Voltage Ripple | -           | -                | -      | -    | 100   | mVp-p |         |
| Power Supply Current      | ICC         | VCC-VSS<br>=3.3V | -      | 18   | 60    | mA    | Note 2  |
| Input signal Voltage      | VIH2        | "H" level        | 0.7VCC | -    | VCC   | V     | Note 1  |
|                           | VIL2        | "L" level        | VSS    | -    | 0.7   |       |         |
| Frame Frequency           | $f_{Frame}$ | -                | 50     | 50   | 60    | Hz    | -       |
| CLK Frequency             | $f_{CLK}$   | -                | 9.34   | 9.70 | 11.19 | MHz   |         |

Note 1: The rating is defined for the signal voltages of the interface such as HD, DEN, VD, NCLK, R0-R7, G0-G7, B0-B7, HRV, VRV, PON.

Note 2: An all white pattern is used when measuring ICC,  $f_{Frame}$  is set to 50 Hz.

Note 3: 630mA fuse is applied in the module for ICC. For display activation and protection purpose, power supply is recommended larger than 1.6A to start the display and break fuse once any short circuit occurred.

## 5.2 BACKLIGHT CHARACTERISTICS

$T_a = 25^\circ\text{C}$

| Item                                 | Symbol | Condition | Min. | Typ. | Max. | Unit | Remarks |
|--------------------------------------|--------|-----------|------|------|------|------|---------|
| LED Input Voltage                    | VB+    | IB+=120mA | 7    | 13.5 | 18   | V    | Note 2  |
| LED Forward Current<br>(PWM Control) | IB+    | 100% duty | -    | 120  | 400  | mA   | Note 2  |
| PWM Signal Voltage                   | VIH1   | "H" level | 2.1  | 3.3  | 5.5  | V    | Note 3  |
|                                      | VIL1   | "L" level | VSS  | -    | 0.4  |      |         |
| LED Lifetime                         | -      | IB+=120mA | -    | 50K  | -    | hrs  | Note 4  |

Note 1: Fig. 5.1 shows the LED backlight circuit.

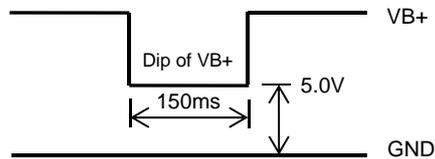
Note.2: Dip of VB+

VB+ can accept +5.0V for 150ms (Backlight will not blinking.)

IB+(max) is 450mA when +5.0V is applied to VB+

Ta=25deg.C PWM=100%

VB+ changes shall not exceed the speed of 2Volt / 100usec.



Note 3: Dimming function can be obtained by applying PWM signal from the display interface, The recommended PWM signal is 150 ~ 250 Hz.

Note 4: The estimated lifetime is specified as the time to reduce 50% brightness by applying 120mA at 25°C.

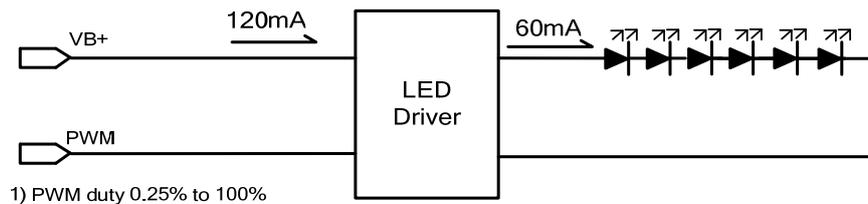


Fig 5.1

## 6. OPTICAL CHARACTERISTICS

The optical characteristics are measured based on the conditions as below:

- Supplying the signals and voltages defined in the section of electrical characteristics.
- The backlight unit needs to be turned on for 30 minutes.
- The ambient temperature is 25 °C .
- In the dark room around 100 lx, the equipment has been set for the measurements as shown in Fig 6.1.

$$T_a = 25 \text{ }^\circ\text{C}, f_{Frame} = 50\text{Hz}, VCC = 3.3\text{V}$$

| Item                  | Symbol        | Condition  | Min.                               | Typ.  | Max.  | Unit              | Remarks |        |
|-----------------------|---------------|--|------------------------------------|-------|-------|-------------------|---------|--------|
| Brightness of White   | -             | IB+= 120mA<br>$\phi = 0^\circ, \theta = 0^\circ$ | 560                                | 750   | -     | cd/m <sup>2</sup> | Note 1  |        |
| Brightness Uniformity | -             |  | 70                                 | 80    | -     | %                 | Note 2  |        |
| Contrast Ratio        | CR            |  | 1000                               | 1500  | -     | -                 | Note 3  |        |
| Response Time         | Tr + Tf       | $\phi = 0^\circ, \theta = 0^\circ$               | -                                  | 25    | -     | ms                | Note 4  |        |
| NTSC Ratio            | -             | $\phi = 0^\circ, \theta = 0^\circ$               | -                                  | 65    | -     | %                 | -       |        |
| Viewing Angle         | $\theta_x$    | $\phi = 0^\circ, CR \geq 10$                     | 70                                 | 85    | -     | Degree            | Note 5  |        |
|                       | $\theta_{x'}$ | $\phi = 180^\circ, CR \geq 10$                   | 70                                 | 85    | -     |                   |         |        |
|                       | $\theta_y$    | $\phi = 90^\circ, CR \geq 10$                    | 70                                 | 85    | -     |                   |         |        |
|                       | $\theta_{y'}$ | $\phi = 270^\circ, CR \geq 10$                   | 70                                 | 85    | -     |                   |         |        |
| Color Chromaticity    | Red           | X  | $\phi = 0^\circ, \theta = 0^\circ$ | 0.572 | 0.622 | 0.672             | Note 6  | Note 6 |
|                       |               | Y  |                                    | 0.298 | 0.348 | 0.398             |         |        |
|                       | Green         | X  |                                    | 0.257 | 0.307 | 0.357             |         |        |
|                       |               | Y  |                                    | 0.563 | 0.613 | 0.663             |         |        |
|                       | Blue          | X  |                                    | 0.100 | 0.150 | 0.200             |         |        |
|                       |               | Y  |                                    | 0.040 | 0.090 | 0.140             |         |        |
|                       | White         | X  |                                    | 0.240 | 0.290 | 0.340             |         |        |
|                       |               | Y  |                                    | 0.270 | 0.320 | 0.370             |         |        |

Note 1: The brightness is measured from 9 point average value of the panel, P5 in Fig. 6.2, for the typical value.

Note 2: The brightness uniformity is calculated by the equation as below:

$$\text{Brightness uniformity} = \frac{\text{Min. Brightness}}{\text{Max. Brightness}} \times 100\%$$

which is based on the brightness values of the 9 points in active area measured by BM-5 as shown in Fig. 6.2.

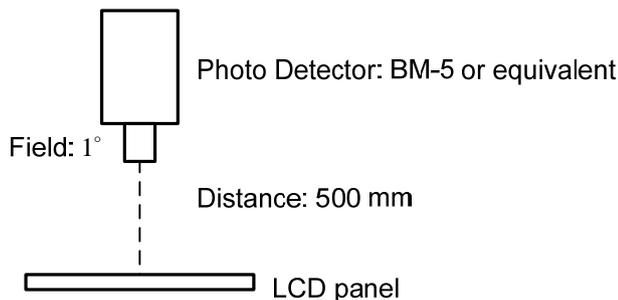


Fig 6.1

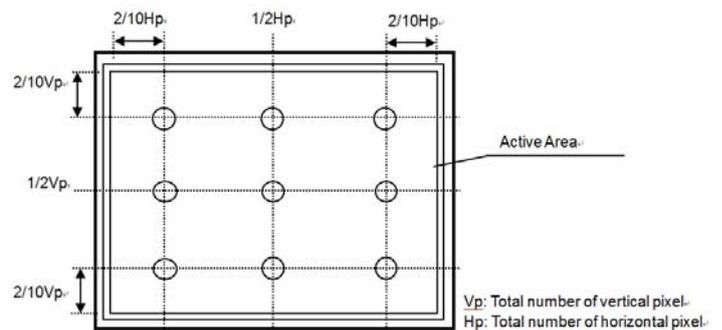


Fig 6.2

Note 3: The Contrast ratio is measured from the center point of the panel, P5, and defined as the following equation:

$$CR = \frac{\text{Brightness of White}}{\text{Brightness of Black}}$$

Note 4: The definition of response time is shown in Fig. 6.3. The rising time is the period from 10% brightness to 90% brightness when the data is from black to white. Oppositely, Falling time is the period from 90% brightness falling to 10% brightness.

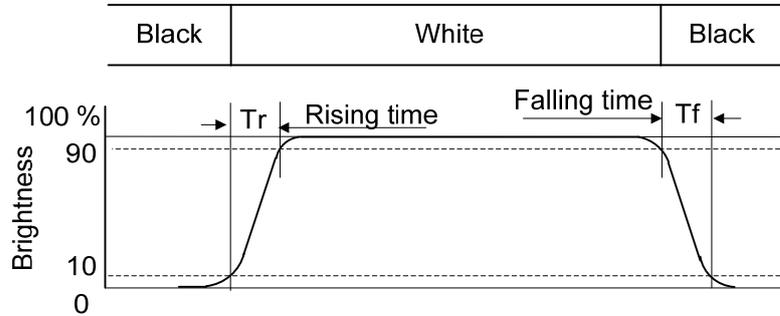


Fig 6.3

Note 5: The definition of viewing angle is shown in Fig. 6.4. Angle  $\phi$  is used to represent viewing directions, for instance,  $\phi = 270^\circ$  means 6 o'clock, and  $\phi = 0^\circ$  means 3 o'clock. Moreover, angle  $\theta$  is used to represent viewing angles from axis Z toward plane XY.

The display is super wide viewing angle version, so that the best optical performance can be obtained from every viewing direction.

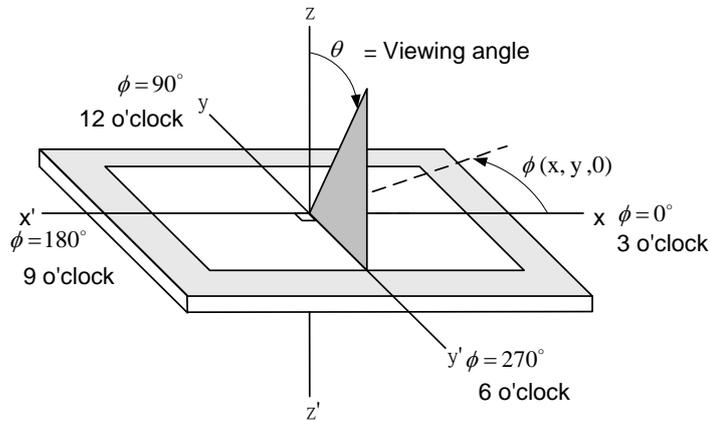
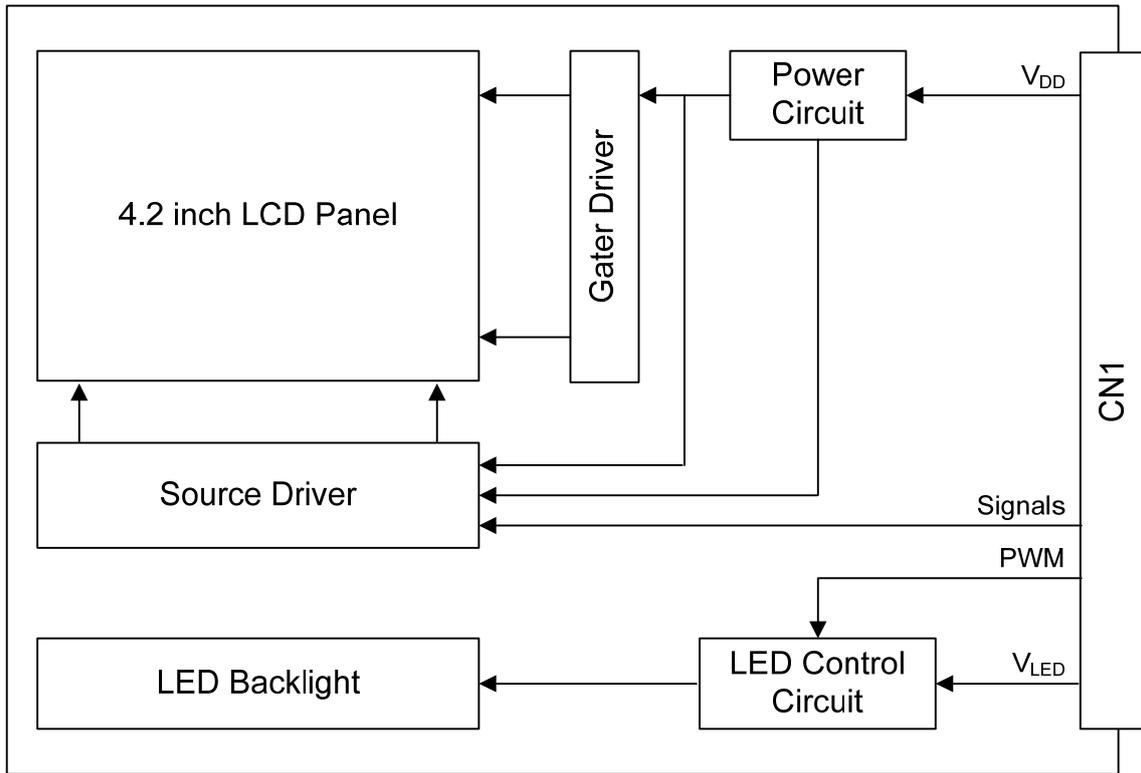


Fig 6.4

Note 6: The color chromaticity is measured from the center point of the panel, P5, as shown in Fig. 6.2.

## 7. BLOCK DIAGRAM



Note 1: Signals are a DEN, VD, HD, NCLK and RGB data bus.

## 8. RELIABILITY TESTS

### 8.1 STANDARD TEST ITEM and CONDITON / METHOD

| Test item                                | Test condition   | Confirm method / Judgment  |
|--|--|--|
| Dry heat Operating                       | 85 deg.C (surface temperature of polarizer), 500Hr   | After 500 hours, product will be left in normal temperature and normal humidity for two hours. It should work without fail mechanically and electrically, and standard in 8.2 has to be met. |
| Low temperature Operating                | -40 deg.C, 500Hr   |  |
| Dry heat Storage                         | 90 deg.C, 500Hr  |  |
| Low temperature Storage                  | -40 deg.C, 500Hr   |  |
| High temperature High humidity Operating | 60 deg.C, 90%RH, 500Hr   |  |
| Thermal shock                            | -40 deg.C(30min.)<br>+85 deg.C(30min.),500 cycles  |  |
| Vibration (Non-operating)                | Frequency: 8~33.3Hz · Amplitude 1.3mm.<br>Frequency: 33.3~400Hz, Acceleration:3G, Cycle 15min.<br>Direction of XZ: 2Hr,<br>Direction of Y: 4Hr | Product should work without fail mechanically and electrically and standard in 8.2 has to be met.  |
| Impact (Non-operating)                   | 100G,6ms, half sin wave, ±XYZ<br>One time for every direction.   | Product should work without fail mechanically and electrically and standard in 8.2 has to be met.  |
| ESD (Non-operating)                      | Contact Discharge<br>150pF, 330ohm, ±15k<br>Panel center<br>3 times (intervals of 1s)<br>Non-operating   | No abnormality like abnormal display.<br>Current consumption should be less than twice of initial value.   |
| ESD (Non-operating)                      | Air Discharge<br>150pF, 330ohm, ±15k<br>4 points to metal frame<br>3 times for each, (intervals of 1s)<br>Non-operating                        | No abnormality like abnormal display.<br>Current consumption should be less than twice of initial value.   |

### 8.2 FAILURE JUDGMENT STANDARD

After reliability test, inspection is executed in the normal temperature / humidity environment

- 1) There should be no remarkable deterioration in display quality and appearance.
- 2) Contrast ratio should be over 50% of initial value.
- 3) Brightness should be over 50% of initial value.
- 4) There should be no abnormal function.
- 5) Current consumption should be less than twice of initial value.

# 9. LCD INTERFACE

## 9.1 INTERFACE PIN CONNECTIONS

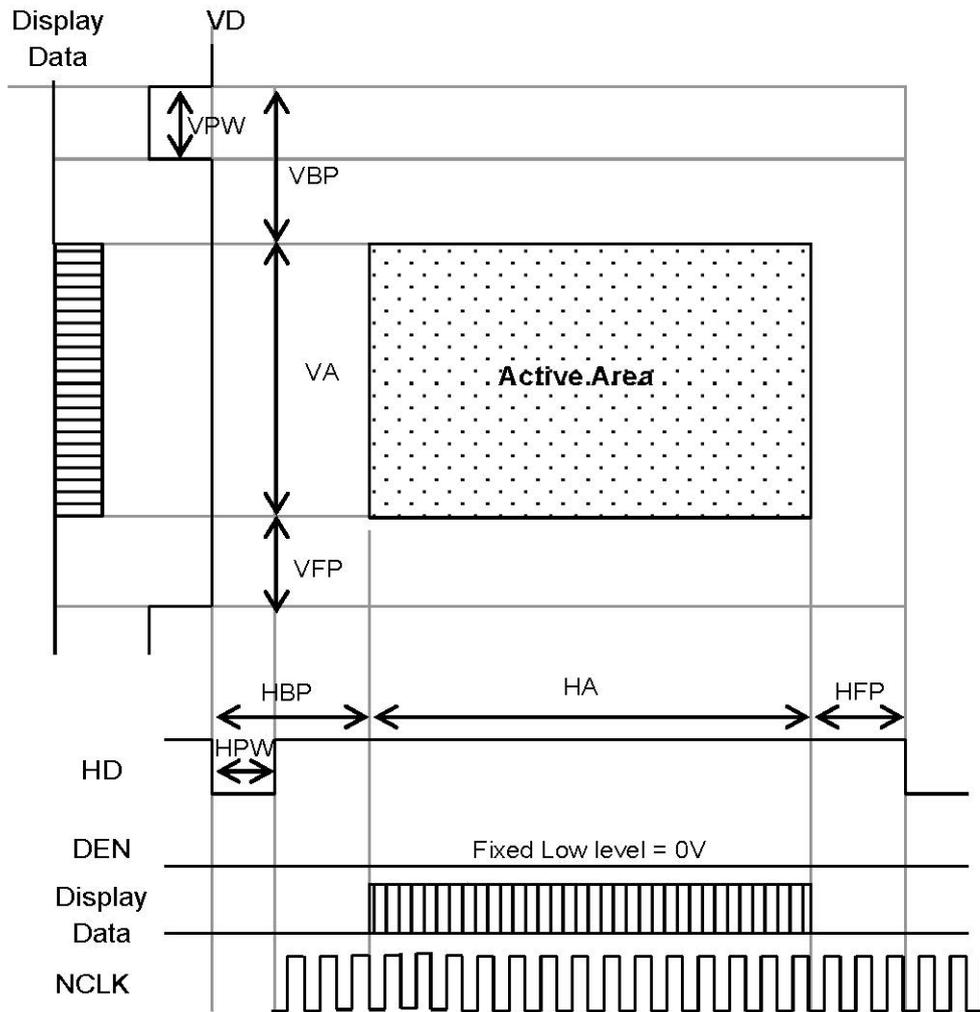
The display interface connector is FH41-068S-0.5SH(0.5) made by HIROSE ELECTRIC and more details of the connector are shown in the section of outline dimension.

Pin assignment of LCD interface is as below:

| Pin No. | Signal | Function                           | Pin No. | Signal | Function                   |
|---------|--------|------------------------------------|---------|--------|----------------------------|
| 1       | TEST   | Continuity to Pin 68               | 35      | R0     | (RGB I/F) Red Data (LSB)   |
| 2       | GND    | GND                                | 36      | GND    | GND                        |
| 3       | GND    | GND                                | 37      | GND    | GND                        |
| 4       | GND    | GND                                | 38      | G7     | (RGB I/F) Green Data (MSB) |
| 5       | GND    | GND                                | 39      | G6     | (RGB I/F) Green Data       |
| 6       | GND    | GND                                | 40      | G5     | (RGB I/F) Green Data       |
| 7       | N.C    | No connection                      | 41      | G4     | (RGB I/F) Green Data       |
| 8       | VB+    | Power Supply Voltage for Backlight | 42      | G3     | (RGB I/F) Green Data       |
| 9       | VB+    | Power Supply Voltage for Backlight | 43      | G2     | (RGB I/F) Green Data       |
| 10      | N.C    | No connection                      | 44      | G1     | (RGB I/F) Green Data       |
| 11      | GND    | GND                                | 45      | G0     | (RGB I/F) Green Data (LSB) |
| 12      | GND    | GND                                | 46      | GND    | GND                        |
| 13      | N.C    | No connection                      | 47      | GND    | GND                        |
| 14      | BL_PWM | Input Signal for Backlight Dimming | 48      | B7     | (RGB I/F) Blue Data (MSB)  |
| 15      | N.C    | No connection                      | 49      | B6     | (RGB I/F) Blue Data        |
| 16      | TEST   | Test Pin                           | 50      | B5     | (RGB I/F) Blue Data        |
| 17      | TEST   | Test Pin                           | 51      | B4     | (RGB I/F) Blue Data        |
| 18      | VRV    | Vertical Scanning Direction        | 52      | B3     | (RGB I/F) Blue Data        |
| 19      | HRV    | Horizontal Scanning Direction      | 53      | B2     | (RGB I/F) Blue Data        |
| 20      | GND    | GND                                | 54      | B1     | (RGB I/F) Blue Data        |
| 21      | GND    | GND                                | 55      | B0     | (RGB I/F) Blue Data(LSB)   |
| 22      | N.C    | No connection                      | 56      | GND    | GND                        |
| 23      | VCC    | Power Supply Voltage               | 57      | GND    | GND                        |
| 24      | VCC    | Power Supply Voltage               | 58      | PON    | Reset Signal               |
| 25      | N.C    | No connection                      | 59      | GND    | GND                        |
| 26      | GND    | GND                                | 60      | GND    | GND                        |
| 27      | GND    | GND                                | 61      | NCLK   | Clock Signal               |
| 28      | R7     | (RGB I/F) Red Data (MSB)           | 62      | GND    | GND                        |
| 29      | R6     | (RGB I/F) Red Data                 | 63      | GND    | GND                        |
| 30      | R5     | (RGB I/F) Red Data                 | 64      | VD     | Vertical Sync              |
| 31      | R4     | (RGB I/F) Red Data                 | 65      | DEN    | Horizontal Data Enable     |
| 32      | R3     | (RGB I/F) Red Data                 | 66      | HD     | Horizontal Sync            |
| 33      | R2     | (RGB I/F) Red Data                 | 67      | GND    | GND                        |
| 34      | R1     | (RGB I/F) Red Data                 | 68      | TEST   | Continuity to Pin 1        |

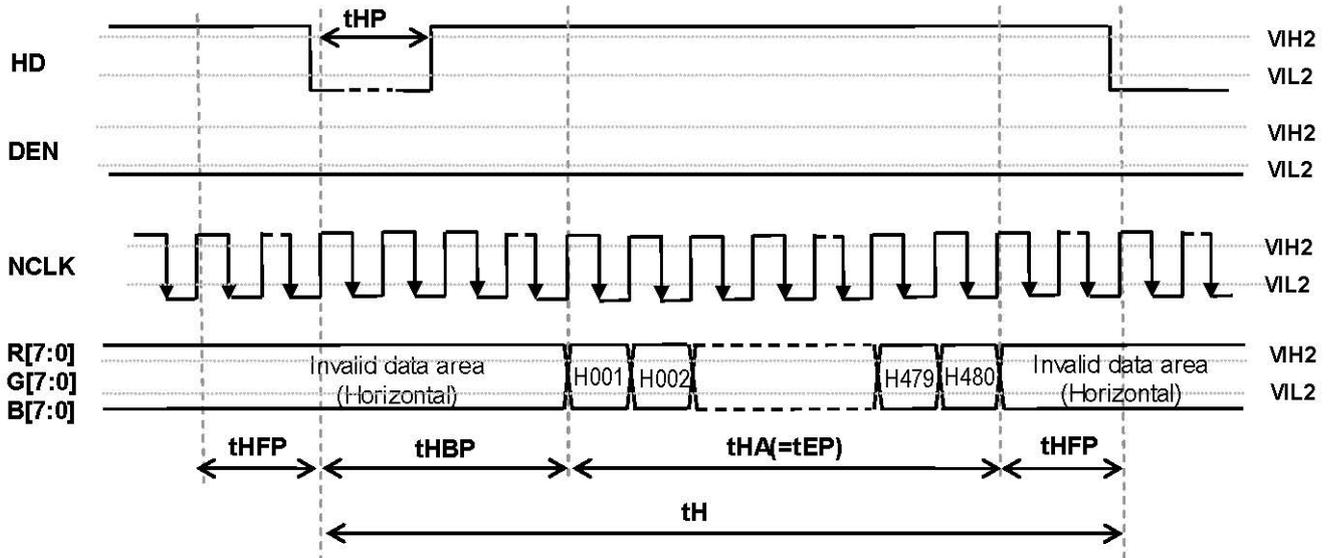
## 9.2 TIMING CHART

### A. GENERAL TIMING DIAGRAM

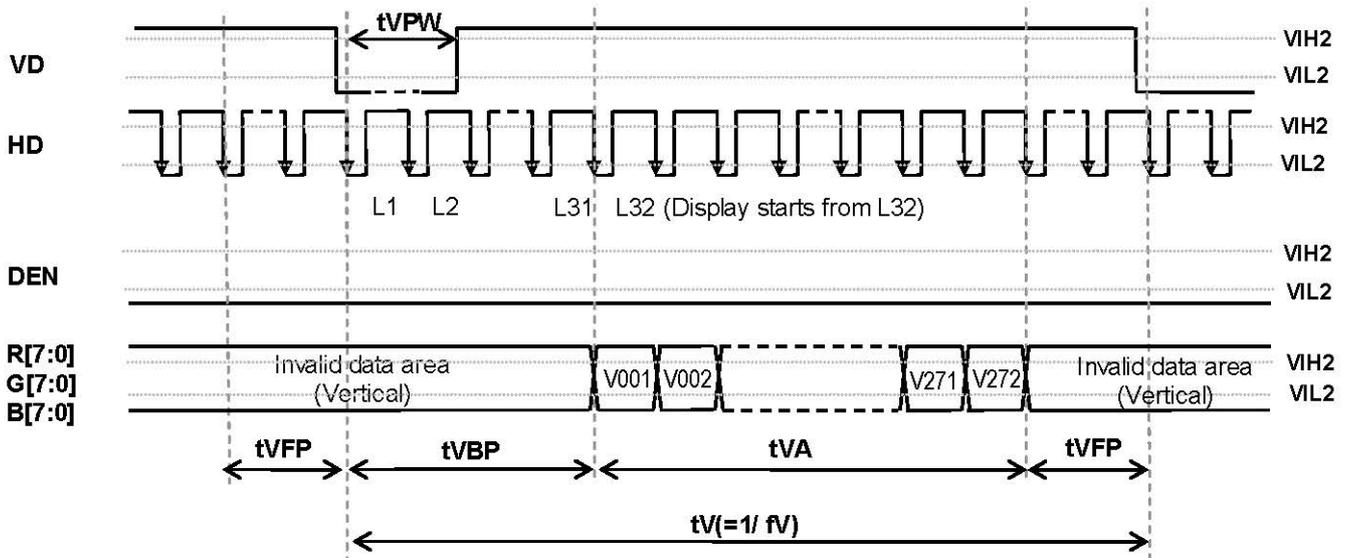


| Condition | Description                    |
|-----------|--------------------------------|
| VPW       | Vertical Sync time (VD=L)      |
| VBP       | Vertical Back Porch            |
| VA        | Vertical Display Active Area   |
| VFP       | Vertical Front Porch           |
| HPW       | Horizontal Sync time (HD=L)    |
| HBP       | Horizontal Back Porch          |
| HA        | Horizontal Display Active Area |
| HFP       | Horizontal Front Porch         |

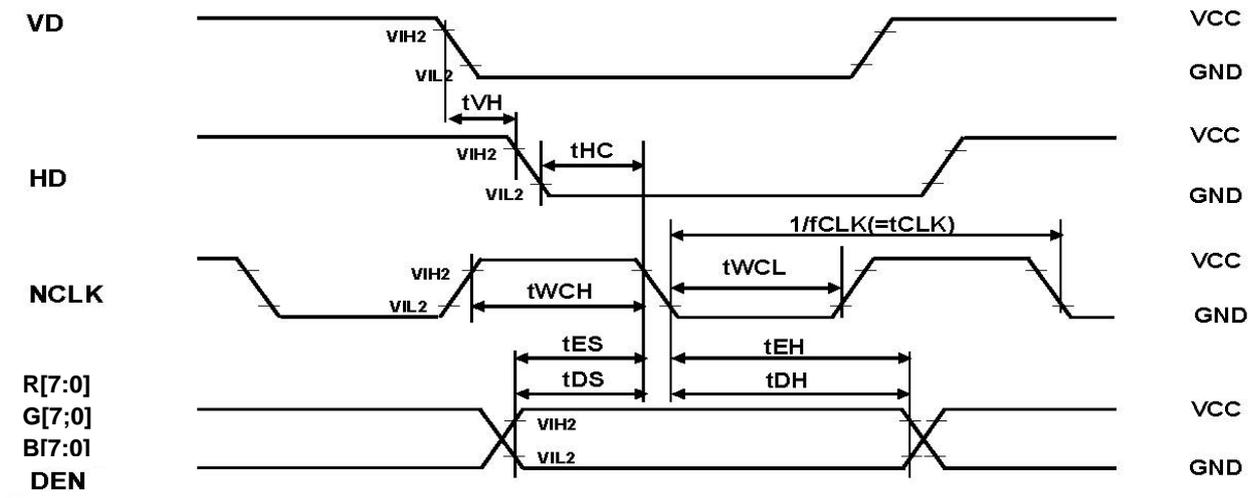
### B. TIMING CHART1 (HORIZONTAL)



### C. TIMING CHART2 (VERTICAL)



### D. TIMING CHART3 (SETUP&HOLD TIME, OTHERS)



### E. JITTER SPECIFICATION 1

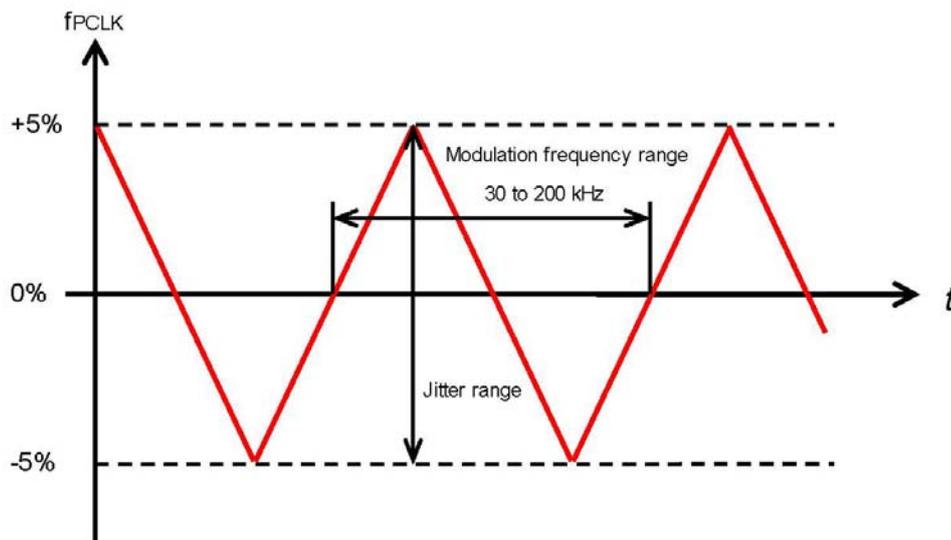
| Parameter                  | Min. | Typ | Max. | Unit | Remarks     |
|----------------------------|------|-----|------|------|-------------|
| Jitter range               | -5   | -   | +5   | %    | Note1, 2, 3 |
| Modulation frequency range | 30   | -   | 200  | kHz  | Note1, 2    |

Note 1: Applicable signals: NCLK, R0-R7, G0-G7, B0-7, HD, VD

Note 2: Data setup and data hold time of signal is according to the timing of A.SYNCHRONOUS MODE..

Note 3: NCLK frequency ( $f_{CLK}$ ) described A.SYNCHRONOUS MODE means Jitter range 0%.

Note 4: KOE can't guarantee the influence to reliability and optical spec.



## F. JITTER SPECIFICATION 2

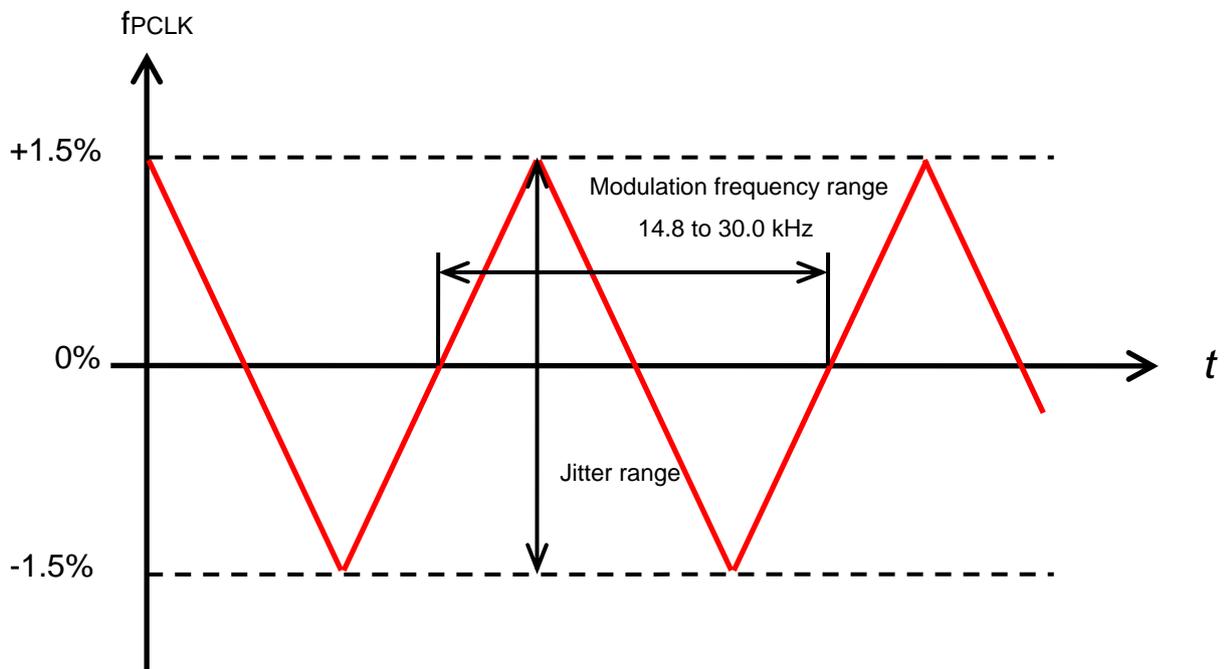
| Parameter                  | Min. | Typ | Max. | Unit | Remarks     |
|----------------------------|------|-----|------|------|-------------|
| Jitter range               | -1.5 | -   | +1.5 | %    | Note1, 2, 3 |
| Modulation frequency range | 14.8 | -   | 30.0 | kHz  | Note1, 2    |

Note 1: Applicable signals: NCLK, R0-R7, G0-G7, B0-7, HD, VD

Note 2: Data setup and data hold time of signal is according to the timing of 9.3 TIMING TABLE.

Note 3: NCLK frequency ( $f_{CLK}$ ) described 9.3 TIMING TABLE means Jitter range 0%.

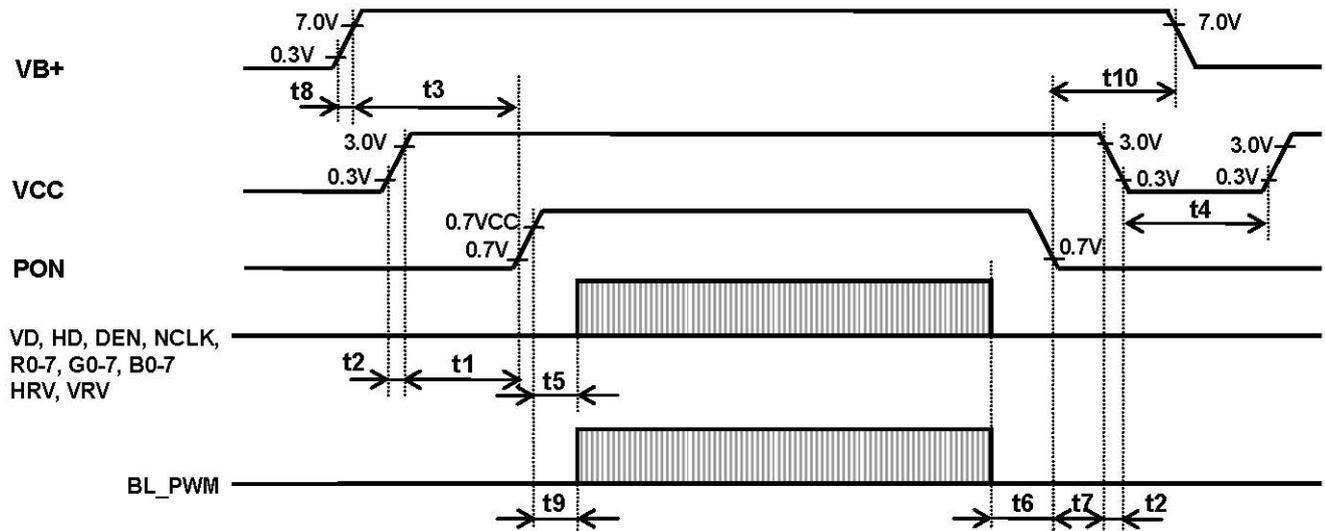
Note 4: KOE can't guarantee the influence to reliability and optical spec.



### 9.3 TIMING TABLE

| Parameter                          |             | Symbol  | Min.       | Typ.   | Max.       | Unit | Description   |
|------------------------------------|-------------|---------|------------|--------|------------|------|---------------|
| Clock<br>[NCLK]                    | Frequency   | fCLK    | 9.34       | 9.70   | 11.19      | MHz  |               |
|                                    | Hi_Time     | tWCH    | 20         | -      | -          | ns   |               |
|                                    | Lo_Time     | tWCL    | 20         | -      | -          | ns   |               |
| Data<br>[R0-7,G0-7,B0-7]           | Setup time  | tDS     | 10         | -      | -          | ns   |               |
|                                    | Hold time   | tDH     | 10         | -      | -          | ns   |               |
| Horizontal sync.<br>signal<br>[HD] | Cycle       | tH(t)   | 54.7       | 64.1   | 69.2       | us   |               |
|                                    |             | tH(clk) | 612        | 622    | 646        | ck   |               |
|                                    | Pulse width | tHPW    | 5          | -      | tH-5       | ck   |               |
| Vertical sync.<br>signal<br>[VD]   | Cycle       | tV      | 305        | 312    | 344        | line |               |
|                                    | Pulse width | tVPW    | 2          | -      | TV-2       | line |               |
| Frame rate                         |             | fV      | 50         | 50     | 60         | Hz   |               |
| Horizontal display period          |             | tHA     | 480        |        |            | ck   | Only 480 ck   |
| HD_NCLK phase difference           |             | tHC     | (tCLK/2)-8 | tCLK/2 | (tCLK/2)+8 | ns   | tCLK=1/fCLK   |
| HD_VD phase difference             |             | tVH     | 0          | -      | tH-1       | ck   |               |
| Vertical front porch               |             | tVFP    | 2          | -      | -          | line |               |
| Vertical back porch                |             | tVBP    | 31         |        |            | line | Only 31 line  |
| Vertical display period            |             | tVA     | 272        |        |            | line | Only 272 line |
| Horizontal front porch             |             | tHFP    | 16         | -      | -          | ck   |               |
| Horizontal back porch              |             | tHBP    | 116        |        |            | ck   | Only 116 ck   |

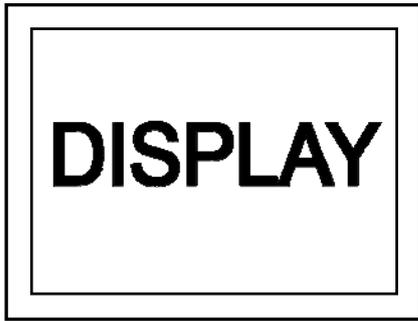
## 9.4 POWER ON/ OFF SEQUENCE



| Symbol | Specification          | Description  |
|--------|------------------------|--|
| t1     | $0 < t1$               | VCC power ON to PON starts timing.                               |
| t2     | $0.2ms < t2 \leq 10ms$ | VCC rise and fall speed. (for reduce inrush current)             |
| t3     | $0 < t3$               | VB+ power ON to PON starts timing.                               |
| t4     | $1000ms < t4$          | VCC power OFF / ON interval. (for discharge DCDC output voltage) |
| t5     | $0 < t5 \leq 10ms$     | PON = High to input signal start timing.                         |
| t6     | $t6 \leq 10ms$         | Input data stop to PON = Low timing.                             |
| t7     | $0 \leq t7$            | PON = Low to VCC power OFF timing.                               |
| t8     | $0.5ms < t8 \leq 10ms$ | VB+ rise speed. (for reduce inrush current)                      |
| t9     | $0.2ms < t9$           | PON = High to BL_PWM signal start timing.                        |
| t10    | $0 < t10$              | PON OFF to VB+ power OFF timing.                                 |

## 9.5 SCAN DIRECTION

Scan direction is available to be switched as below by setting CN1's VRV & HRV pin.



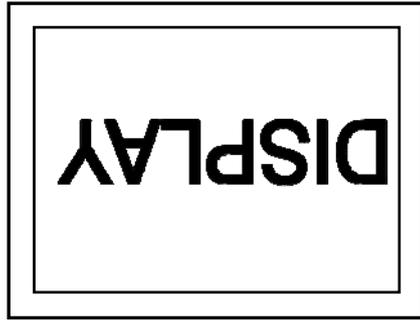
HRV : H ; VRV : H



HRV : L ; VRV : H



HRV : H ; VRV : L

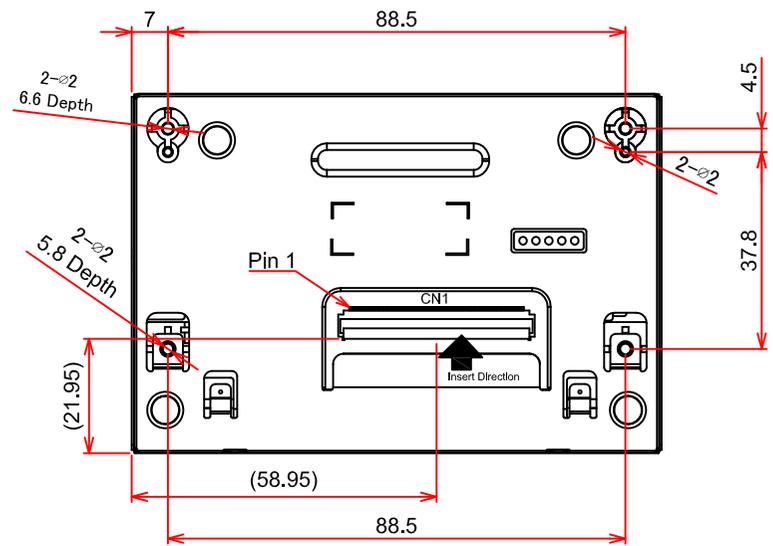
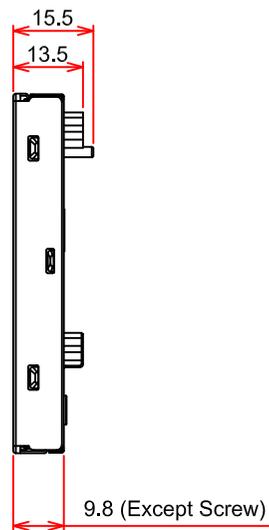
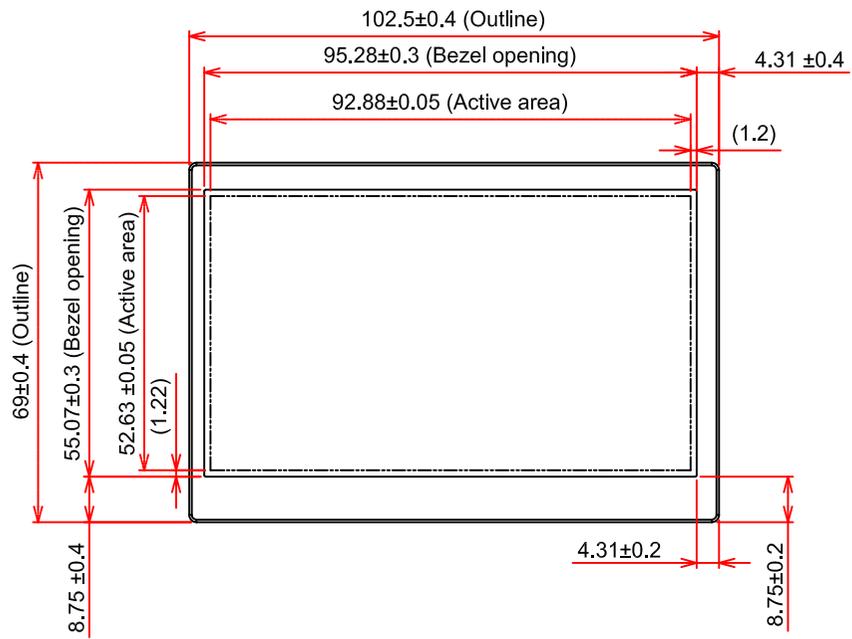


HRV : L ; VRV : L

## 9.6 DATA INPUT for DISPLAY COLOR

| Input color |            | Red Data |    |    |    |    |    |    |    | Green Data |    |    |    |    |    |    |    | Blue Data |    |    |    |    |    |    |    |     |  |  |  |  |  |
|-------------|------------|----------|----|----|----|----|----|----|----|------------|----|----|----|----|----|----|----|-----------|----|----|----|----|----|----|----|-----|--|--|--|--|--|
|             |            | R7       | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7         | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7        | B6 | B5 | B4 | B3 | B2 | B1 | B0 |     |  |  |  |  |  |
|             |            | MSB      |    |    |    |    |    |    |    | LSB        |    |    |    |    |    |    |    | MSB       |    |    |    |    |    |    |    | LSB |  |  |  |  |  |
| Basic Color | Black      | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Red        | H        | H  | H  | H  | H  | H  | H  | H  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Green      | L        | L  | L  | L  | L  | L  | L  | L  | H          | H  | H  | H  | H  | H  | H  | H  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Blue       | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | H         | H  | H  | H  | H  | H  | H  | H  |     |  |  |  |  |  |
|             | Cyan       | L        | L  | L  | L  | L  | L  | L  | L  | H          | H  | H  | H  | H  | H  | H  | H  | H         | H  | H  | H  | H  | H  | H  | H  |     |  |  |  |  |  |
|             | Magenta    | H        | H  | H  | H  | H  | H  | H  | H  | L          | L  | L  | L  | L  | L  | L  | L  | H         | H  | H  | H  | H  | H  | H  | H  |     |  |  |  |  |  |
|             | Yellow     | H        | H  | H  | H  | H  | H  | H  | H  | H          | H  | H  | H  | H  | H  | H  | H  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | White      | H        | H  | H  | H  | H  | H  | H  | H  | H          | H  | H  | H  | H  | H  | H  | H  | H         | H  | H  | H  | H  | H  | H  | H  |     |  |  |  |  |  |
| Red         | Black      | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Red(1)     | L        | L  | L  | L  | L  | L  | H  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Red(2)     | L        | L  | L  | L  | L  | L  | H  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | :          | :        | :  | :  | :  | :  | :  | :  | :  | :          | :  | :  | :  | :  | :  | :  | :  | :         | :  | :  | :  | :  | :  | :  | :  |     |  |  |  |  |  |
|             | Red(254)   | H        | H  | H  | H  | H  | H  | H  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Red(255)   | H        | H  | H  | H  | H  | H  | H  | H  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
| Green       | Black      | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Green(1)   | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | H  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Green(2)   | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | H  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | :          | :        | :  | :  | :  | :  | :  | :  | :  | :          | :  | :  | :  | :  | :  | :  | :  | :         | :  | :  | :  | :  | :  | :  | :  |     |  |  |  |  |  |
|             | Green(254) | L        | L  | L  | L  | L  | L  | L  | L  | H          | H  | H  | H  | H  | H  | H  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Green(255) | L        | L  | L  | L  | L  | L  | L  | L  | H          | H  | H  | H  | H  | H  | H  | H  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
| Blue        | Black      | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | L  |     |  |  |  |  |  |
|             | Blue(1)    | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | L  | H  |     |  |  |  |  |  |
|             | Blue(2)    | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | L         | L  | L  | L  | L  | L  | H  | L  |     |  |  |  |  |  |
|             | :          | :        | :  | :  | :  | :  | :  | :  | :  | :          | :  | :  | :  | :  | :  | :  | :  | :         | :  | :  | :  | :  | :  | :  | :  |     |  |  |  |  |  |
|             | Blue(254)  | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | H         | H  | H  | H  | H  | H  | H  | L  |     |  |  |  |  |  |
|             | Blue(255)  | L        | L  | L  | L  | L  | L  | L  | L  | L          | L  | L  | L  | L  | L  | L  | L  | H         | H  | H  | H  | H  | H  | H  | H  |     |  |  |  |  |  |

# 10. OUTLINE DIMENSIONS



General Tolerance:  $\pm 0.5$  mm  
 Scale : NTS  
 Unit : mm

# 11. APPEARANCE STANDARD

## 11.1 CLASSIFICATION OF DEFECTS

Defects are classified as major defect and a minor defect according to the degree of defect defined herein.

a) Major defect

A major defect is a defect that is likely to result in failure, or to reduce materially the usability of the product for its intended purpose.

Function defect

abnormal operation including distinct R,G,B line defects and /or white line defect

b) Minor defect

A minor defect either is a defect that is not likely to reduce materially the usability of the product for its intended purpose, or is a departure from an established having little bearing on the effective use or operation of the product.

1).Dot defect. 2) Display non-uniformity. 3).Extraneous substances

4).Scratches. 5).Dents. 6).Current dissipation

Specific criteria of judgment on major and/or minor defects or otherwise shall be accordance with the attached "Classification of Defect"

## 11.2 ACCEPTABLE QUALITY LEVEL("AQL")

The AQL for major and minor defects shall be respectively set forth below.

a) Major defects: AQL :0.4

b) Minor defects: AQL :1.0

Note: If one bright dot is detected from the module that was supplied as a "0" bright dot module,  
The agreed quantity of modules shall be secured as replacements apart from out compensation.

## 11.3 METHOD OF SAMPLING INSPECTION

a) Lot size : Quantity per shipment lot per model

b) Sampling type : Normal inspection, Single sampling

c) Inspection level : II

d) Sampling table : Table in ISO 2859-1

### 11.4 INSPECTION CONDITION

| Item                 | Inspection Conditions                                 |
|----------------------|---|
| Ambient Illumination | Operating: 25 ~150 lux<br>Non operating: 800~2000 lux |
| Ambient temperature  | 25±5°C  |
| Ambient Humidity     | 60±20% RH   |
| Viewing distance     | 350mm or more   |
| Viewing angle        | At perpendicular                                      |
| How to use ND filter | Use ND filter open to eyes                            |

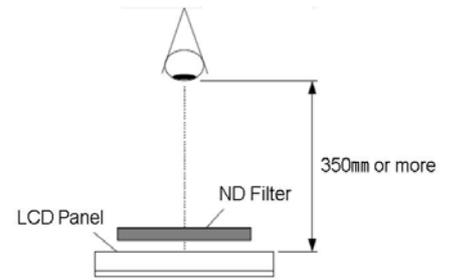


Fig.11-1

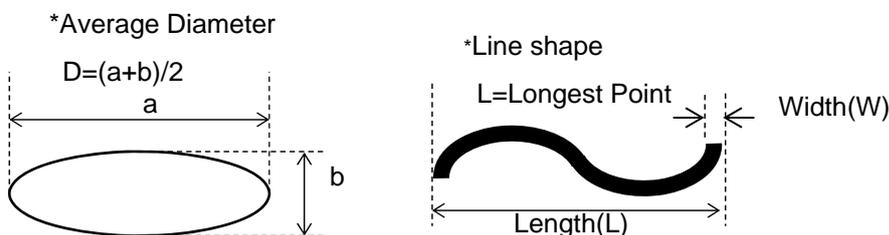
### 11.5 EXTERNAL INSPECTION

Average Diameter :D (mm), Length :L (mm), Width :W(mm)

| Items to be inspected                      | Inspection Criteria      |  |            | Note       |    |
|--|--------------------------|--|------------|------------|----|
|  | No Count                 | Count  |            |            | NG |
| Black or White Spots                       | $D < 0.15$               | $0.15 \leq D \leq 0.50$                            | $N \leq 2$ | $D > 0.50$ | *1 |
| Lint                                       | $L < 0.15$ or $W < 0.05$ | $0.15 \leq L \leq 3.0$ and $0.05 \leq W \leq 0.15$ | $N \leq 2$ | Others     | *1 |
| Scratch on the color filter and black mask | $L < 1$ or $W < 0.05$    | $1 \leq L \leq 10$ and $0.05 \leq W \leq 0.15$     | $N \leq 3$ | Others     | *1 |
| Polarizer Scratch                          | $L < 1$ or $W < 0.05$    | $1 \leq L \leq 10$ and $0.05 \leq W \leq 0.15$     | $N \leq 2$ | Others     | *2 |
| Polarizer Dent or Bubbles                  | $D < 0.15$               | $0.15 \leq D \leq 0.50$                            | $N \leq 2$ | $D > 0.50$ | *2 |

**\*External Substance**

Note 1: Module operating (Black or White picture mode):



Note 2: Module non-operating (The External Visual Inspection):

The inspection shall be conducted by using a single fluorescent lamp for illumination, and viewable distance to LCD and from inspection eye shall be 350mm or more.

# 11.6 VISUAL INSPECTION

## 11.6.1 Zone

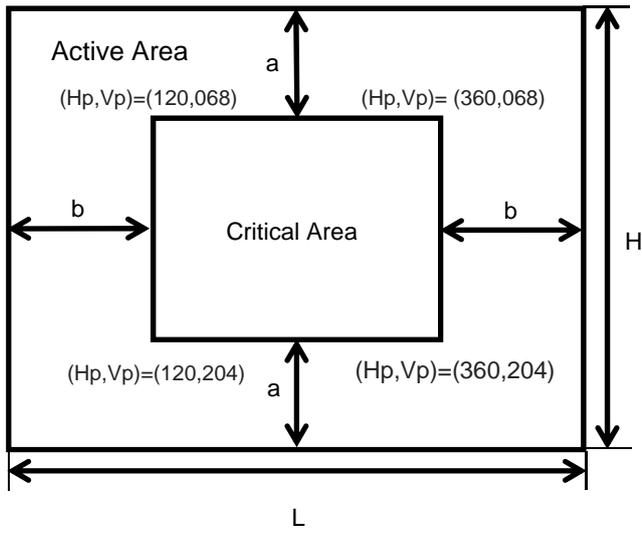


Fig.11-2

Effective Display Area(Active Area)  
of specification about H,L

Critical Display Area(exclusion area)of  
specification about a,b.  
a,b; Critical Area  $\geq 25\%$  Active Area

\*Critical Area is defined as inside of the following  
pixels.  
 $(H_p, V_p) = (120, 068) - (120, 204) - (360, 068) - (360, 204)$   
:Refer to following Fig.11-2.

11.6.2 Define

| No | Item   |  | Define  |
|----|--|--|---|
| A  | Dot  | Pixel  | 3 sub-pixels(R+G+B)                                     |
|    |  | Dot  | 1 sub-pixel (R or G or B)                               |
| B  | Bright dot<br>PPL Dot<br>(pixel to pixel leak) | When the Module lights, dots appear bright on the display with a Black, Red, Green or Blue picture position.               |   |
|    |  | Count  | Visible through 5% ND Filter.                           |
|    |  | No count   | Not visible through 5% ND Filter.                       |
| C  | Black dot                                      | When the Module lights, dots appear black or faint color on the display with a White, Red, Green or Blue picture position. |   |
| D  | Black spot                                     | When the Module lights, It appears circular shape extraneous substance with a black or white picture position.             |   |
|    |  | Count  | Visible through 5% ND Filter.                           |
|    |  | No count   | Not visible through 5% ND Filter.                       |
| E  | Lint   | When the Module lights, It appears linear shape extraneous substance with a black or white picture position.               |   |
|    |  | Count  | Visible through 5% ND Filter.                           |
|    |  | No count   | Not visible through 5% ND Filter.                       |
| F  | Polarizar Scratch                              | When the Module no operating, It appears a scratch on the Polarizar.   |   |
|    |  | Count  | Based on size criteria <u>11.5 External Inspection.</u> |
|    |  | No count   | Based on size criteria <u>11.5 External Inspection.</u> |
| G  | Polarizar Dent                                 | When the Module no operating, It appears a dent on the Polarizar.  |   |
|    |  | Count  | Based on size criteria <u>11.5 External Inspection.</u> |
|    |  | No count   | Based on size criteria <u>11.5 External Inspection.</u> |
| H  | Scratch on the color filter                    | When the Module lights, dots appear bright on the display with a Black, Red, Green or Blue picture position.               |   |
|    |  | Count  | Visible through 5% ND Filter.                           |
|    |  | No count   | Not visible through 5% ND Filter.                       |
| I  | Scratch on the black mask                      | When the Module lights, dots appear bright on the display with a Black, Red, Green or Blue picture position.               |   |
|    |  | Count  | Visible through 5% ND Filter.                           |
|    |  | No count   | Not visible through 5% ND Filter.                       |

11.6.3 Number of Transmission defects/(Acceptable)

| Defect Description                     | Active Area | Critical Area |
|--|-------------|---------------|
| Bright Dot (including PPL Dot) (Note1) | 0           | 0             |
| Scratch on the Color Filter            | 0           | 0             |
| Scratch on the Black Mask              | 0           | 0             |
| Black Dot                              | 3           | 0             |
| Black spots (White spots)              | 2 (Note 2)  | 0             |
| Lint                                   | 2(Note 2)   | 0             |
| Total (operating)                      | 3           | 0             |
| Polarizer Scratch                      | 2           | 0             |
| Polarizer Dent                         | 2           | 0             |
| Total (no operating)                   | 2           | 0             |

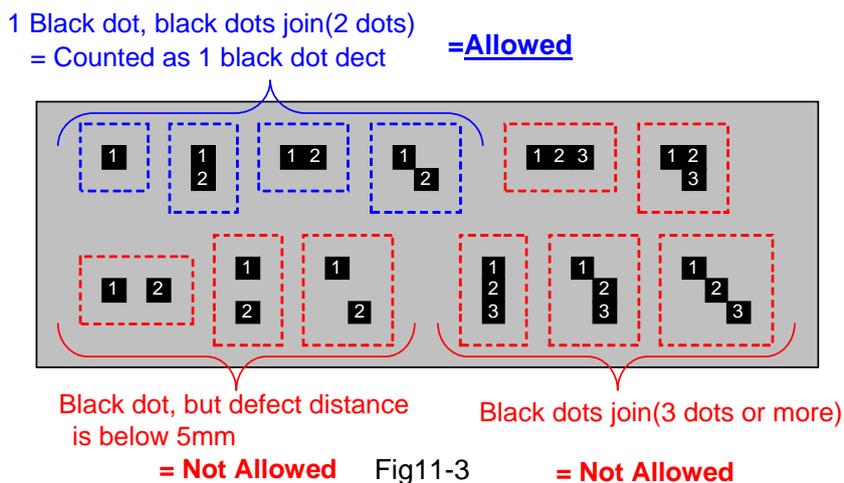
Note 1: Dots that blink shall be categorized as Bright Dot.

Note 2: Based on size criteria 11.5 External Inspection.

11.6.4 Defect distance & join

| Item                            | Standards             |
|---------------------------------|-----------------------|
| Black dots distance             | 5mm or more *1        |
| Black dots join(2 dots)         | 1(black dot) count *1 |
| Black dots join(3 dots or more) | Not Allowed           |

Note 1:\* Black dots join(2 dots) is counted as 1 Black dot defect. (Refer to following Fig.5-3.)



11.7 DISPLAY NON-UNIFORMITY

There should be no distinct non-uniformity visible through 2% ND Filter.

## 12. PRECAUTIONS

### 12.1 PRECAUTIONS of ESD

- 1) Before handling the display, please ensure your body has been connected to ground to avoid any damages by ESD. Also, do not touch display's interface directly when assembling.
- 2) Please remove the protection film very slowly before turning on the display to avoid generating ESD.

### 12.2 PRECAUTIONS of HANDLING

- 1) In order to keep the appearance of display in good condition; please do not rub any surfaces of the displays by sharp tools harder than 3H, especially touch panel, metal frame and polarizer.
- 2) Please do not pile the displays in order to avoid any scars leaving on the display. In order to avoid any injuries, please pay more attention for the edges of glasses and metal frame, and wear finger cots to protect yourself and the display before working on it.
- 3) Touching the display area or the terminal pins with bare hand is prohibited. This is because it will stain the display area and cause poor insulation between terminal pins, and might affect display's electrical characteristics furthermore.
- 4) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean display's surfaces.
- 5) Please use soft cloth or absorbent cotton with ethanol to clean the display by gently wiping. Moreover, when wiping the display, please wipe it by horizontal or vertical direction instead of circling to prevent leaving scars on the display's surface, especially polarizer.
- 6) Please wipe any unknown liquids immediately such as saliva, water or dew on the display to avoid color fading or any permanently damages.
- 7) Maximum pressure to the surface of the display must be less than  $1.96 \times 10^4$  Pa. If the area of adding pressure is less than  $1 \text{ cm}^2$ , the maximum pressure must be less than 1.96N.

### 12.3 PRECAUTIONS OF OPERATING

- 1) Please input signals and voltages to the displays according to the values defined in the section of electrical characteristics to obtain the best performance. Any voltages over than absolute maximum rating will cause permanent damages to this display. Also, any timing of the signals out of this specification would cause unexpected performance.
- 2) When the display is operating at significant low temperature, the response time will be slower than it at  $25 \text{ C}^\circ$ . In high temperature, the color will be slightly dark and blue compared to original pattern. However, these are temperature-related phenomenon of LCD and it will not cause permanent damages to the display when used within the operating temperature.
- 3) The use of screen saver or sleep mode is recommended when static images are likely for long periods of time. This is to avoid the possibility of image sticking.
- 4) Spike noise can cause malfunction of the circuit. The recommended limitation of spike noise is no bigger than  $\pm 100 \text{ mV}$ .

## 12.4 PRECAUTIONS of STORAGE

If the displays are going to be stored for years, please be aware the following notices.

- 1) Please store the displays in a dark room to avoid any damages from sunlight and other sources of UV light.
- 2) The recommended long-term storage temperature is between 10 C° ~35 C° and 55%~75% humidity to avoid causing bubbles between polarizer and LCD glasses, and polarizer peeling from LCD glasses.
- 3) It would be better to keep the displays in the container, which is shipped from KOE, and do not unpack it.
- 4) Please do not stick any labels on the display surface for a long time, especially on the polarizer.

### 13. DESIGNATION of LOT MARK

1) The lot mark is showing in Fig.13.1. First 4 digits are used to represent production lot, T represented made in Taiwan, and the last 6 digits are the serial number.

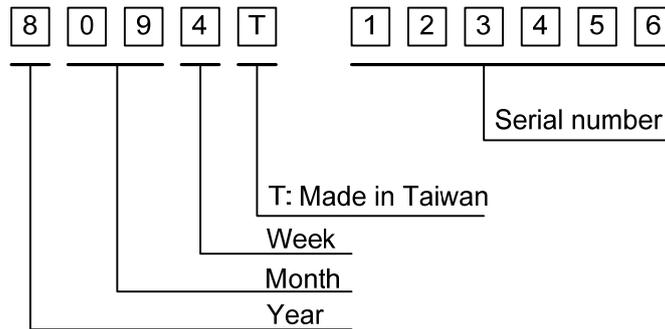


Fig. 13.1

2) The tables as below are showing what the first 4 digits of lot mark are shorted for.

| Year | Lot Mark |
|------|----------|
| 2018 | 8        |
| 2019 | 9        |
| 2020 | 0        |
| 2021 | 1        |
| 2022 | 2        |

| Month | Lot Mark | Month | Lot Mark |
|-------|----------|-------|----------|
| Jan.  | 01       | Jul.  | 07       |
| Feb.  | 02       | Aug.  | 08       |
| Mar.  | 03       | Sep.  | 09       |
| Apr.  | 04       | Oct.  | 10       |
| May   | 05       | Nov.  | 11       |
| Jun.  | 06       | Dec.  | 12       |

| Week       | Lot Mark |
|------------|----------|
| 1~7 days   | 1        |
| 8~14 days  | 2        |
| 15~21 days | 3        |
| 22~28 days | 4        |
| 29~31 days | 5        |

3) Except letters I and O, revision number will be shown on lot mark and following letters A to Z.

4) The location of the lot mark is on the back of the display shown in Fig. 13.2.

Label example:

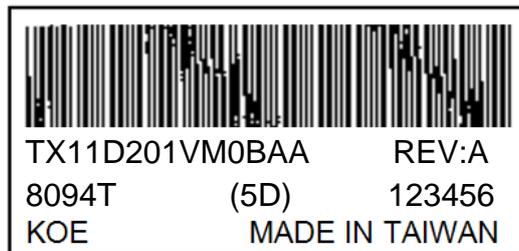


Fig. 13.2