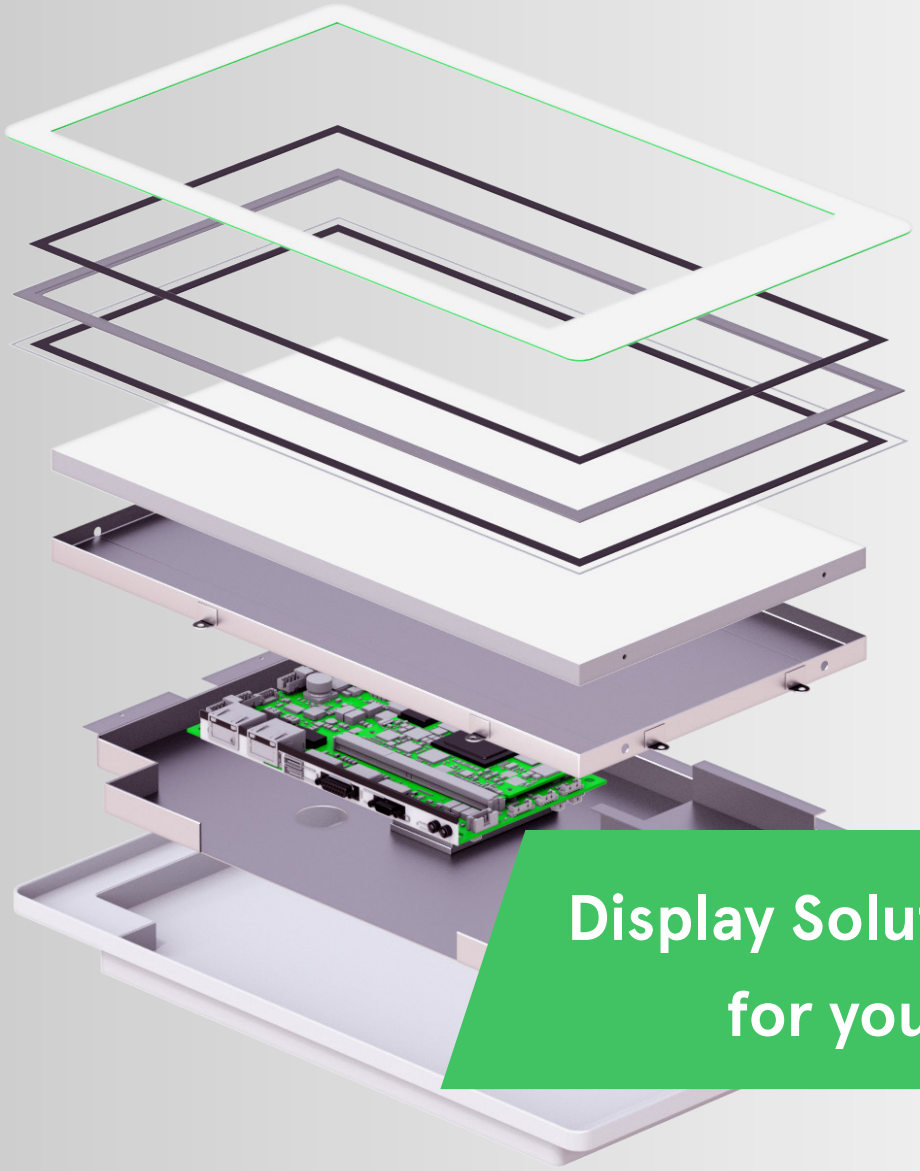
AVNET EMBEDDED



# Display Solutions tailored for your Application

## DATASHEET

**TX23D203VM0BPA**

Note: This specification and revision is subject to change without prior notice.

KOE

JDI Group

Kaohsiung Opto-Electronics Inc.

FOR MESSRS : _____ DATE : Jun. 21st ,2021

# CUSTOMER'S ACCEPTANCE SPECIFICATIONS

# TX23D203VM0BPA

## Contents



ACCEPTED BY: _____ PROPOSED BY: Oblack Tsai

# 2. RECORD OF REVISION

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# 3. GENERAL DATA

## 3.1 DISPLAY FEATURES

This module is a 9” WVGA of 16:9 format of 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 , and COG (chip on glass) technology and LED backlight are applied on this display.

| | |
|---|---|
| Part Name | TX23D203VM0BPA |
| Module Dimensions | 218.0(W) mm x 135.0(H) mm x 12.65 (D) mm |
| LCD Active Area | 196.8(W) mm x 118.08(H) mm |
| Pixel Pitch | 0.246(W) mm x 0.246(H) mm |
| Resolution | 800 x 3(RGB)(W) x 480(H) Dots |
| Color Pixel Arrangement | R, G, B Vertical stripe |
| LCD Type | Transmissive Color TFT; Normally Black |
| Display Type | Active Matrix |
| Number of Colors | 16.7M Colors(6-bit + FRC) |
| Backlight | Light Emitting Diode (LED) |
| Weight | 415 g (typ.) |
| Interface | LVDS ; 20 pins |
| Power Supply Voltage | 3.3V for LCD ; 12.0V for Backlight |
| Power Consumption | 1.2 W for LCD ; 4.8W for backlight |
| Viewing Direction | Super Wide Version (In Plane Switching) |
| Touch Panel | Resistive type; Film on Glass, 4-wire type; Antiglare surface |

# 4. ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Min. | Max. | Unit | Remarks |
|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | -0.3 | 4.0 | V | - |
| Input Voltage of Logic | $V_I$ | -0.3 | $V_{DD}$+0.3 | V | Note 1 |
| Operating Temperature | $T_{op}$ | -20 | 70 | ˚C | Note 2 |
| Storage Temperature | $T_{st}$ | -30 | 80 | ˚C | Note 2 |
| Backlight Input Voltage | $V_{LED}$ | - | 15 | V | - |

Note 1: The rating is defined for the signal voltages of the interface such as, DIM, SD, AMODE, CLK and pixel data prirs.

Note 2: The maximum rating is defined as above based on the chamber temperature, which might be different from ambient temperature after assembling the panel into the application. Moreover, some temperature-related phenomenon as below needed to be noticed:

- Background color, contrast and response time would be different in temperatures other than 25˚C.
- Operating under high temperature will shorten LED lifetime.

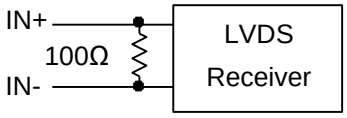
# 5. ELECTRICAL CHARACTERISTICS

## 5.1 LCD CHARACTERISTICS

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

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| Power Supply Voltage | $V_{DD}$ | - | 3.0 | 3.3 | 3.6 | V | - |
| Input Voltage of Logic | $V_I$ | "H" level | - | - | +100 | mV | Note 1 |
| | | "L" level | -100 | - | - | | |
| Signal Input Voltage | $V_I$ | "H" level | $0.7V_{DD}$ | - | $V_{DD}$ | V | CMOS Level |
| | | "L" level | 0 | - | $0.3V_{DD}$ | | |
| Power Supply Current | $I_{DD}$ | $V_{DD}$-$V_{SS}$ =3.3V | 330 | 370 | 430 | mA | Note 2,3 |
| Frame Frequency | $f_{Frame}$ | - | - | 60 | 75 | Hz | - |
| DCLK Frequency | $f_{CLK}$ | - | - | 33.3 | 35 | MHz | |

Note 1: VCM 1.2V is common mode voltage of LVDS transmitter and receiver. The input terminal of LVDS receiver is terminated with 100Ω.




Note 2: An all white check pattern is used when measuring $I_{DD}$. $f_{Frame}$ is set to 60 Hz

Note 3: 1.0A fuse is applied in the module for $I_{DD}$. For display activation and protection purpose, power supply is recommended larger than 2.5A to start the display and break fuse once any short circuit occurred.

## 5.2 BACKLIGHT CHARACTERISTICS

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

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| LED Input Voltage | $V_{LED}$ | - | 11.5 | 12.0 | 12.5 | V | Note1 |
| LED Forward Current (Dim control) | $I_{LED}$ | 0V; 0% duty | 360 | 400 | 440 | mA | |
| | | 3.3VDC; 100% duty | 42 | 45 | 47 | | |
| LED lifetime | - | $I_{LED}$ = 400mA | - | 70K | - | hrs | Note 2 |

Note 1: As Fig. 5.1 shown, LED current is constant, 400mA, controlled by the LED driver when applying 12V.

Note 2: The estimated lifetime is specified as the time to reduce 50% brightness by applying 400mA at 25°C.

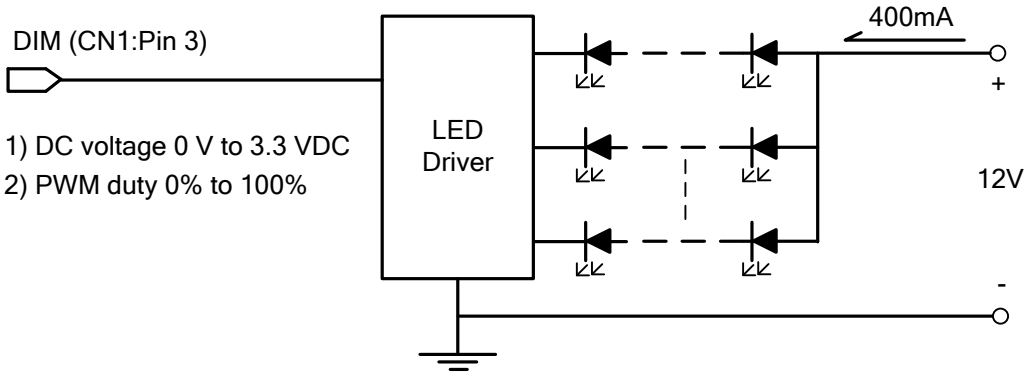



Fig. 5.1

# 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 15 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.

$T_a = 25\,^{\circ}C,\ f_{Frame} = 60\,\text{Hz},\ V_{DD} = 3.3V$

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| Brightness of White | | - | $\phi = 0^{\circ}, \theta = 0^{\circ}$, $I_{LED}$= 400mA | 640 | 800 | - | $cd/m^2$ | Note 1 |
| Brightness Uniformity | | - | | 75 | - | - | % | Note 2 |
| Contrast Ratio | | CR | | 700 | 1000 | - | - | Note 3 |
| Response Time (Rising + Falling) | | Tr + Tf | $\phi = 0^{\circ}, \theta = 0^{\circ}$ | - | 40 | - | ms | Note 4 |
| NTSC Ratio | | - | $\phi = 0^{\circ}, \theta = 0^{\circ}$ | - | 72 | - | % | - |
| Viewing Angle | | $\theta$ x | $\phi = 0^{\circ}$, CR ≥ 10 | - | 85 | - | Degree | Note 5 |
| | | $\theta$ x′ | $\phi = 180^{\circ}$, CR ≥ 10 | - | 85 | - | | |
| | | $\theta$ y | $\phi = 90^{\circ}$, CR ≥ 10 | - | 85 | - | | |
| | | $\theta$ y′ | $\phi = 270^{\circ}$, CR ≥ 10 | - | 85 | - | | |
| Color Chromaticity | Red | X | $\phi = 0^{\circ}, \theta = 0^{\circ}$ | 0.59 | 0.64 | 0.69 | - | Note 6 |
| | | Y | | 0.30 | 0.35 | 0.40 | | |
| | Green | X | | 0.27 | 0.32 | 0.37 | | |
| | | Y | | 0.57 | 0.62 | 0.67 | | |
| | Blue | X | | 0.09 | 0.14 | 0.19 | | |
| | | Y | | 0.01 | 0.06 | 0.11 | | |
| | White | X | | 0.25 | 0.30 | 0.35 | | |
| | | Y | | 0.27 | 0.32 | 0.37 | | |

Note 1: The brightness is measured from the panel center point, 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 measured by BM-5 as shown in Fig. 6.2.

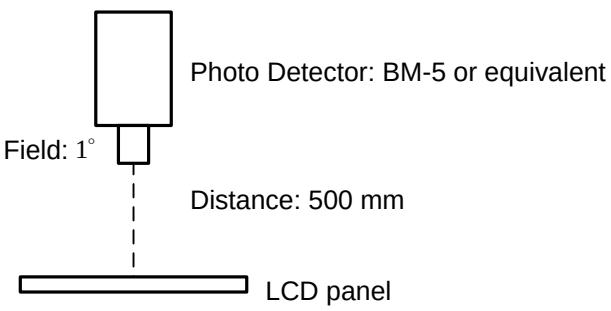



Fig. 6.1

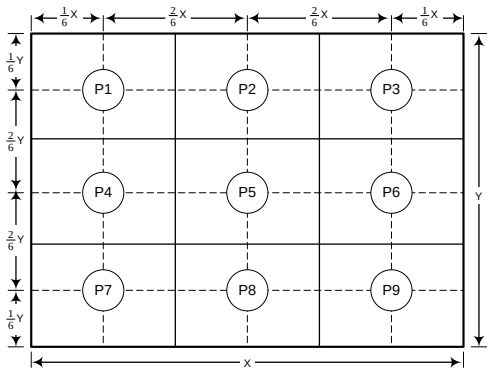



Fig. 6.2

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 rising to 10% brightness.

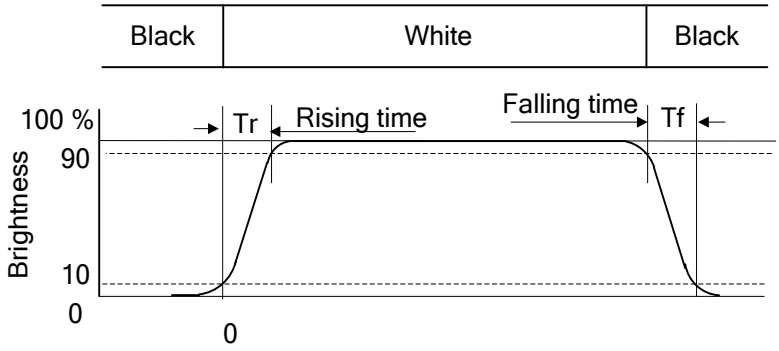



Fig. 6.3

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; 85° viewing angle can be obtained from each viewing direction.

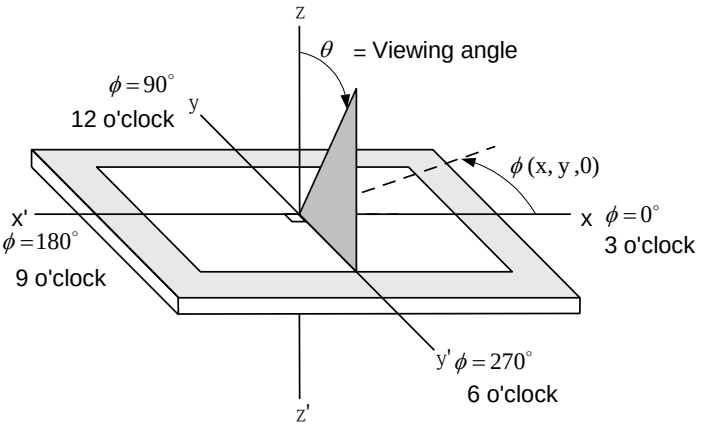
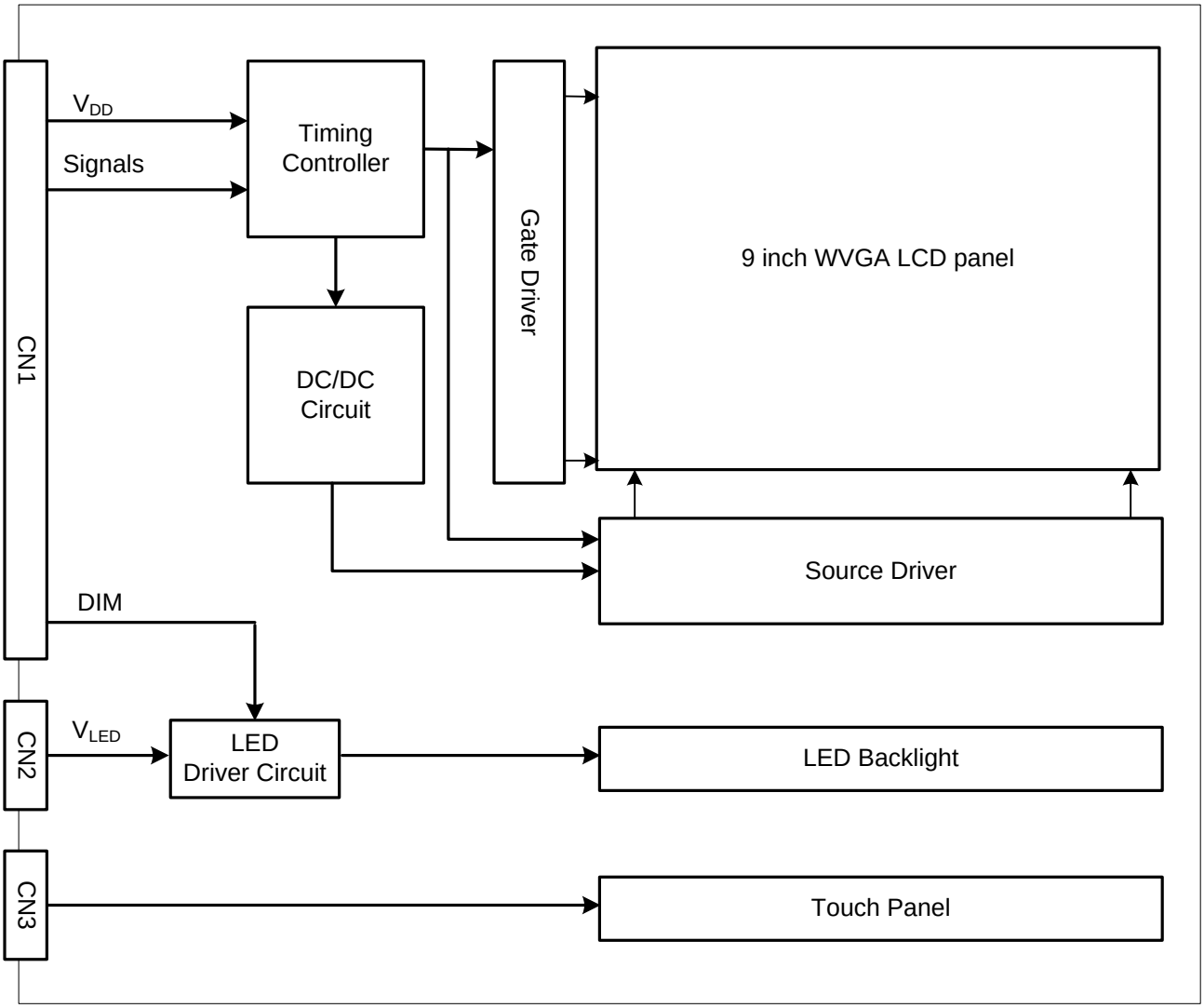



Fig. 6.4

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

# 7. BLOCK DIAGRAM



# 8. RELIABILITY TESTS

| Test Item | Condition | |
|---|---|---|
| High Temperature | 1) Operating<br>2) 70°C | 240 hrs |
| Low Temperature | 1) Operating<br>2) -20°C | 240 hrs |
| High Temperature | 1) Storage<br>2) 80°C | 240 hrs |
| Low Temperature | 1) Storage<br>2) -30°C | 240 hrs |
| Heat Cycle | 1) Operating<br>2) –20°C ~70°C<br>3) 3hrs~1hr~3hrs | 240 hrs |
| Thermal Shock | 1) Non-Operating<br>2) -35°C↔85°C<br>3) 0.5 hr↔0.5 hr | 240 hrs |
| High Temperature & Humidity | 1) Operating<br>2) 40°C & 85%RH<br>3) Without condensation | 240 hrs<br>(Note 3) |
| Vibration | 1) Non-Operating<br>2) 20～200 Hz<br>3) 2G<br>4) X, Y, and Z directions | 1 hr for each direction |
| Mechanical Shock | 1) Non-Operating<br>2) 10 ms<br>3) 50G<br>4) ±X, ±Y and ±Z directions | Once for each direction |
| ESD | 1) Operating<br>2) Tip: 200 pF, 250Ω<br>3) Air discharge for glass: ± 8KV<br>4) Contact discharge for metal frame: ± 8KV | 1) Glass: 9 points<br>2) Metal frame: 8 points<br>(Note 4) |

Note 1: Display functionalities are inspected under the conditions defined in the specification after the reliability tests.

Note 2: The display is not guaranteed for use in corrosive gas environments.

Note 3: Under the condition of high temperature & humidity, if the temperature is higher than 40℃, the humidity needs to be reduced as Fig. 8.1 shown.

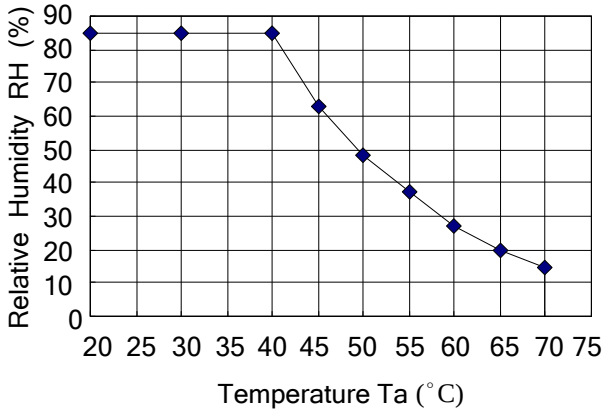



Fig. 8.1

Note 4: All pins of LCD interface(CN1) have been tested by ±100V contact discharge of ESD under non-operating condition.

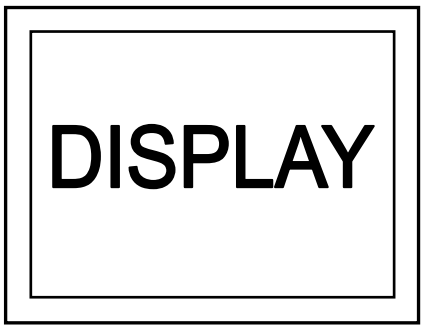
# 9. LCD INTERFACE

## 9.1 INTERFACE PIN CONNECTIONS

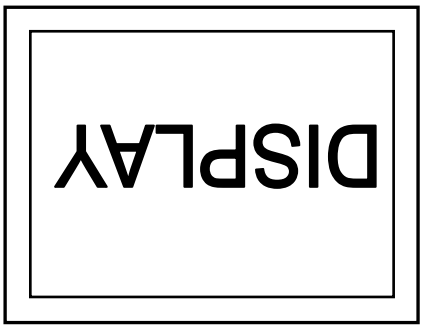
The display interface connector CN1 is FI-SEB20P-HF13E made by JAE and more details of the connector are shown in the section of outline dimension. Pin assignment of LCD interface is as below:

| Pin No. | Signal | Signal | Pin No. | Signal | Signal |
|---|---|---|---|---|---|
| 1 | $V_{DD}$ | Power Supply (typ.+3.3V) | 11 | IN2- | Pixel Data |
| 2 | $V_{DD}$ | | 12 | IN2+ | |
| 3 | DIM | Backlight diming (Note 3) | 13 | $V_{SS}$ | GND |
| 4 | $V_{SS}$ | GND | 14 | CLK IN- | Pixel Clock |
| 5 | IN0- | Pixel Data | 15 | CLK IN+ | |
| 6 | IN0+ | | 16 | $V_{SS}$ | GND |
| 7 | $V_{SS}$ | GND | 17 | IN3- | Pixel Data |
| 8 | IN1- | Pixel Data | 18 | IN3+ | |
| 9 | IN1+ | | 19 | SD | Scan Direction Control (Note 1) |
| 10 | $V_{SS}$ | GND | 20 | AMODE | L:8bit(default),H:8bit/6bit |

Note 1: Scan direction is available to be switched as below.




SD：Low or Open (Default)




SD：High

Note 2: In n- and n+ (n=0,1,2,3), CLK IN- and CLK IN+ should be wired by twist-pairs or side by side FPC patterns, respectively.

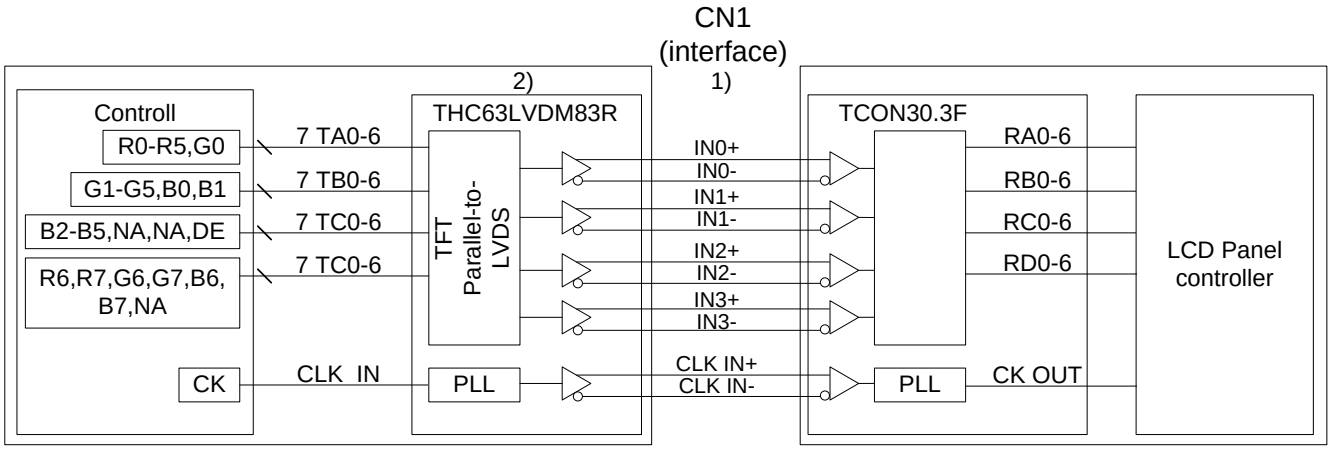
Note 3: Normal brightness: 0V or 0% PWM duty; Brightness control: 0V to 3.3V DC or 0% to 100% PWM duty.

The backlight interface connector CN2 is SM08B-SRSS-TB made by JST, and pin assignment of backlight is as below:

| Pin No. | Signal | Function |
|---|---|---|
| 1~3 | $V_{LED}$+ | Power Supply for LED(12V) |
| 4~5 | NC | No Connection |
| 6~8 | $V_{LED}$- | GND |

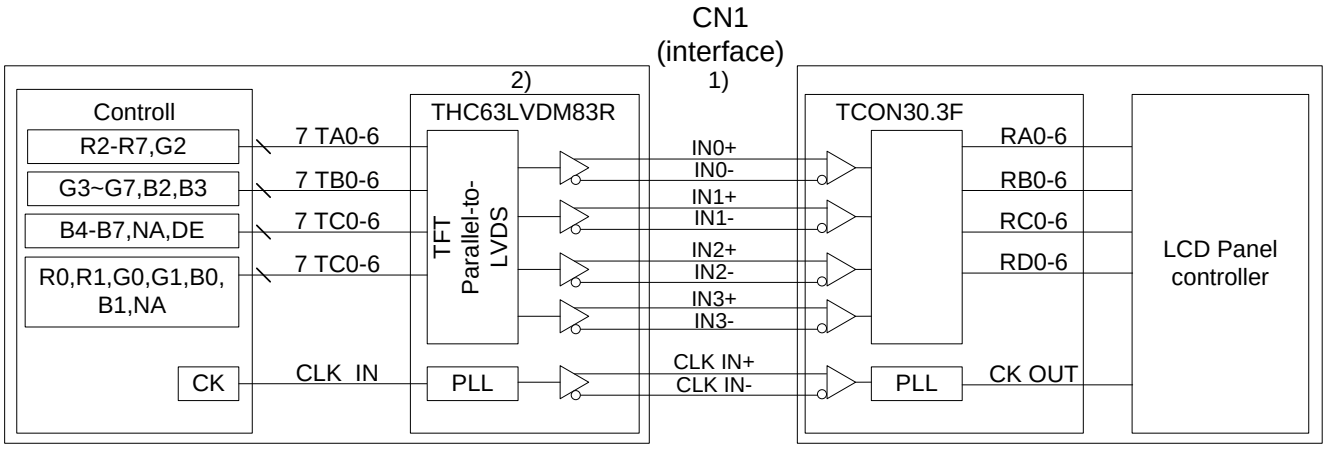
9.2 LVDS INTERFACE

1) 8Bit Mode ( AMODE = LOW )

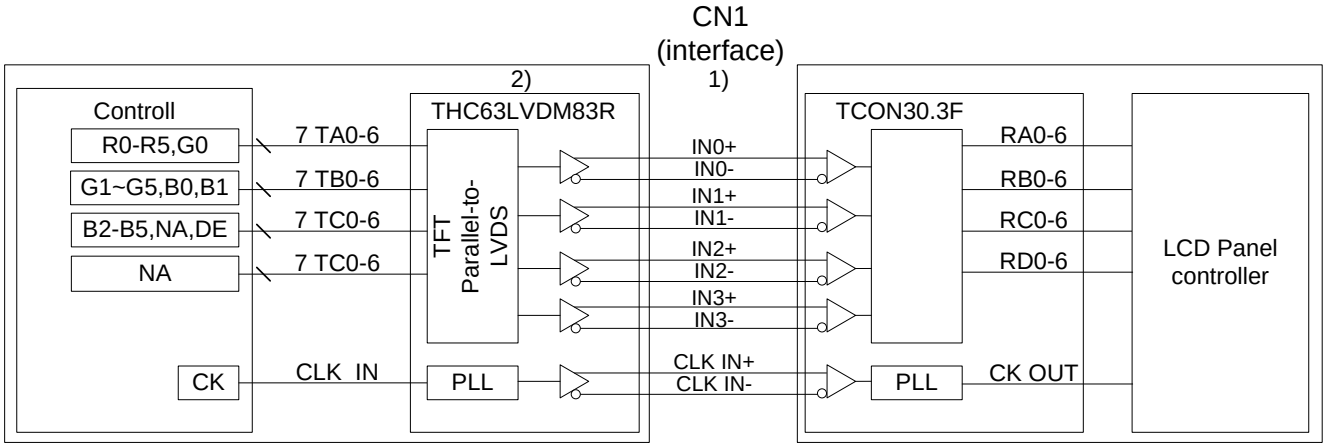



2) 8Bit / 6Bit Mode( AMODE = HIGH )

① 8Bit Mode




② 6Bit Mode



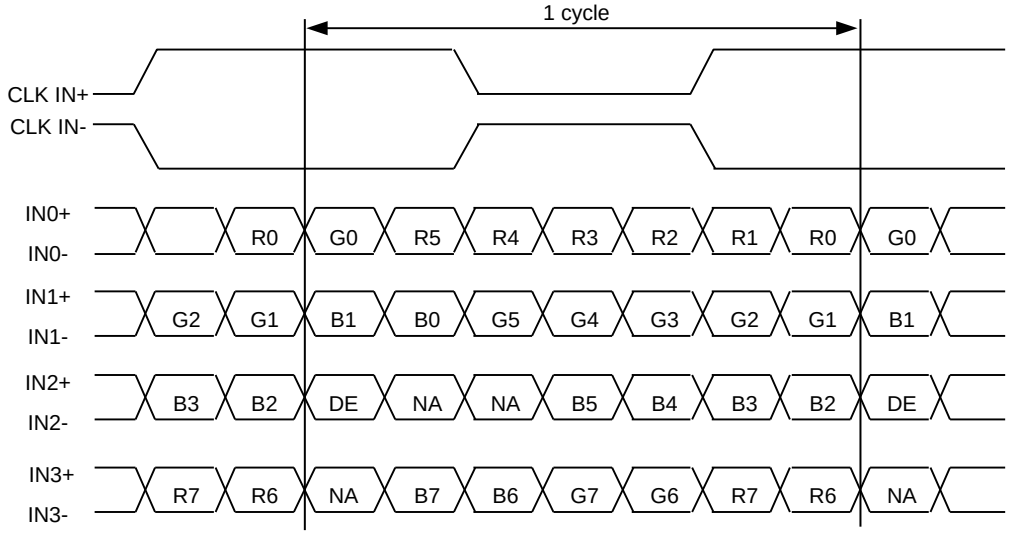

Note 1: 100Ω impedance of LVDS cable is recommended for best optical performance.

Note 2: Transmitter Made by Thine : THC63LVDM83R or equivalent.

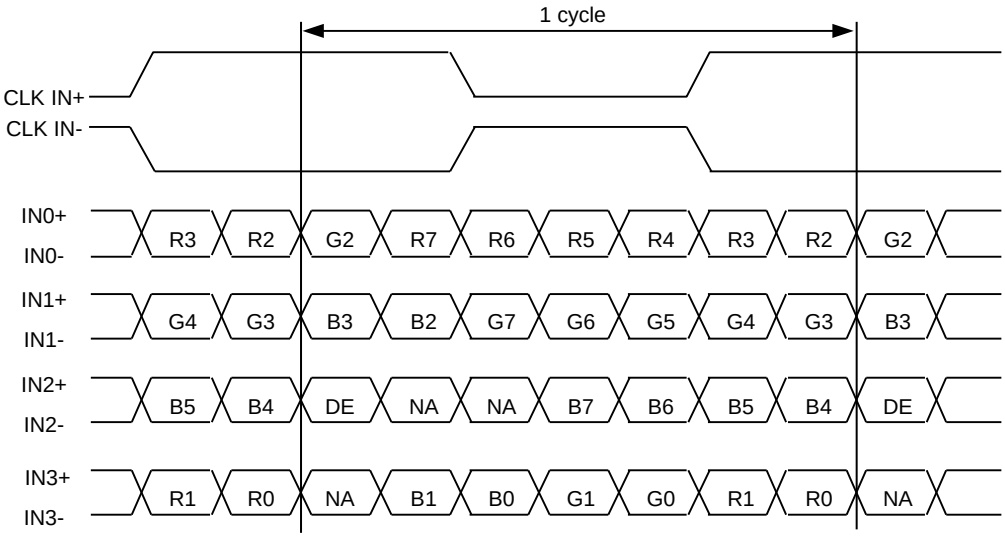
## 9.3 DATA MAPPING

| Transmitter | | 8Bit Mode | 8Bit Mode | 6Bit Mode |
|---|---|---|---|---|
| Pin No. | Pin name | AMODE | | |
| | | LOW | HIGH | |
| 51 | TA0 | R0(LSB) | R2 | R0(LSB) |
| 52 | TA1 | R1 | R3 | R1 |
| 54 | TA2 | R2 | R4 | R2 |
| 55 | TA3 | R3 | R5 | R3 |
| 56 | TA4 | R4 | R6 | R4 |
| 3 | TA5 | R5 | R7(MSB) | R5(MSB) |
| 4 | TA6 | G0(LSB) | G2 | G0(LSB) |
| 6 | TB0 | G1 | G3 | G1 |
| 7 | TB1 | G2 | G4 | G2 |
| 11 | TB2 | G3 | G5 | G3 |
| 12 | TB3 | G4 | G6 | G4 |
| 14 | TB4 | G5 | G7(MSB) | G5(MSB) |
| 15 | TB5 | B0(LSB) | B2 | B0(LSB) |
| 19 | TB6 | B1 | B3 | B1 |
| 20 | TC0 | B2 | B4 | B2 |
| 22 | TC1 | B3 | B5 | B3 |
| 23 | TC2 | B4 | B6 | B4 |
| 24 | TC3 | B5 | B7(MSB) | B5(MSB) |
| 27 | TC4 | (NA) | (NA) | (NA) |
| 28 | TC5 | (NA) | (NA) | (NA) |
| 30 | TC6 | DE | DE | DE |
| 50 | TD0 | R6 | R0(LSB) | (NA) |
| 2 | TD1 | R7(MSB) | R1 | (NA) |
| 8 | TD2 | G6 | G0(LSB) | (NA) |
| 10 | TD3 | G7(MSB) | G1 | (NA) |
| 16 | TD4 | B6 | B0(LSB) | (NA) |
| 18 | TD5 | B7(MSB) | B1 | (NA) |
| 25 | TD6 | (NA) | (NA) | (NA) |

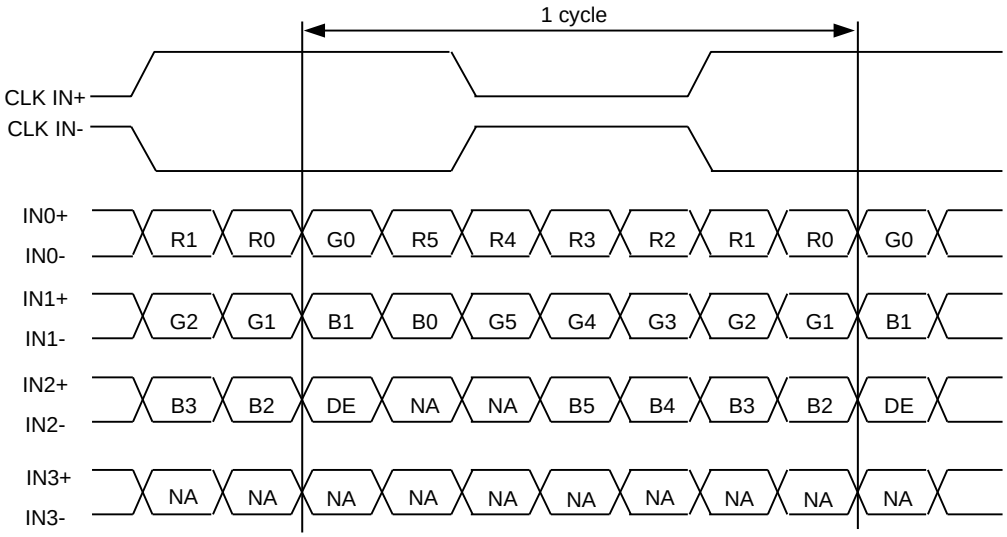
(1) 8Bit Mode (Amode=Low)




(2) 8Bit Mode (Amode=High)




(3) 6Bit Mode (Amode=High)




DE : Display Enable

NA : Not Available

## 9.4 DATA INPUT for DISPLAY COLOR

(8 BIT MODE)

| Input | | 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 |
| | color | MSB | | | | | | | LSB | MSB | | | | | | | LSB | MSB | | | | | | | LSB |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 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 | 0 | 0 |
| | Red(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 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 | 0 | 0 |
| | Green(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(253) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Note 1: Definition of gray scale : Color(n) Number in parenthesis indicates gray scale level. Larger number corresponds to brighter level.

Note 2: Data Signal : 1 : High, 0 : Low

(6 BIT MODE)

| Input color | | Red Data | | | | | | Green Data | | | | | | Blue Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| | | MSB | | | | | LSB | MSB | | | | | LSB | MSB | | | | | LSB |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 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 |
| Red | Black | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(2) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red(61) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Black | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green(61) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Black | 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 | 1 |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue(61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

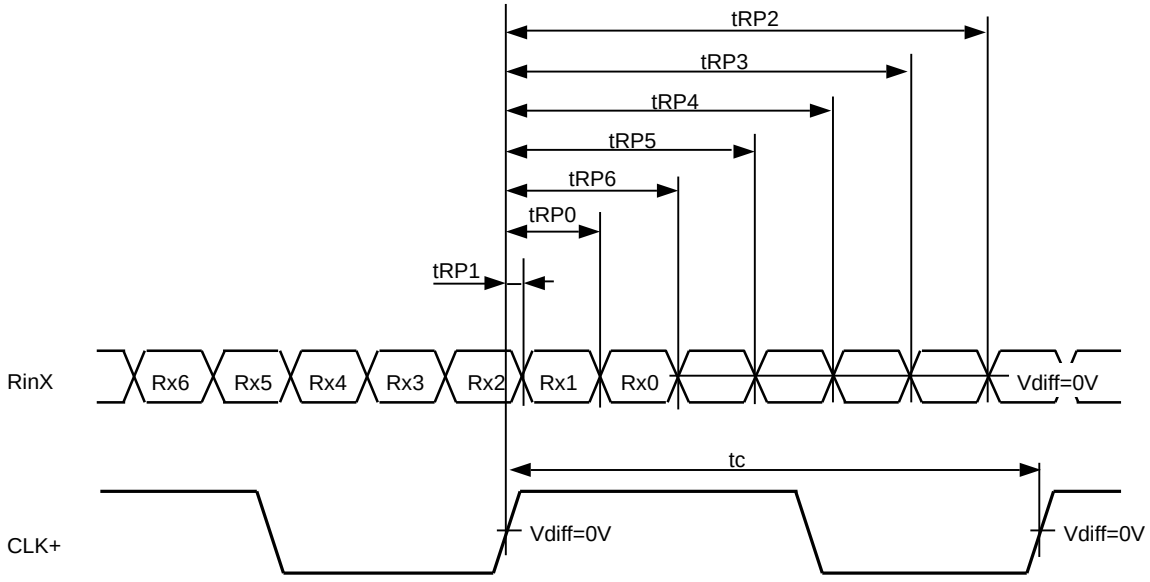
Note 1: Definition of gray scale : Color(n) Number in parenthesis indicates gray scale level. Larger number corresponds to brighter level.

Note 2: Data Signal : 1 : High, 0 : Low

## 9.5 INTERFACE TIMING

(1) LVDS Receiver Timing

(Interface of TFT module)




RinX=(RinX+)-(RinX-) (X=0,1,2)

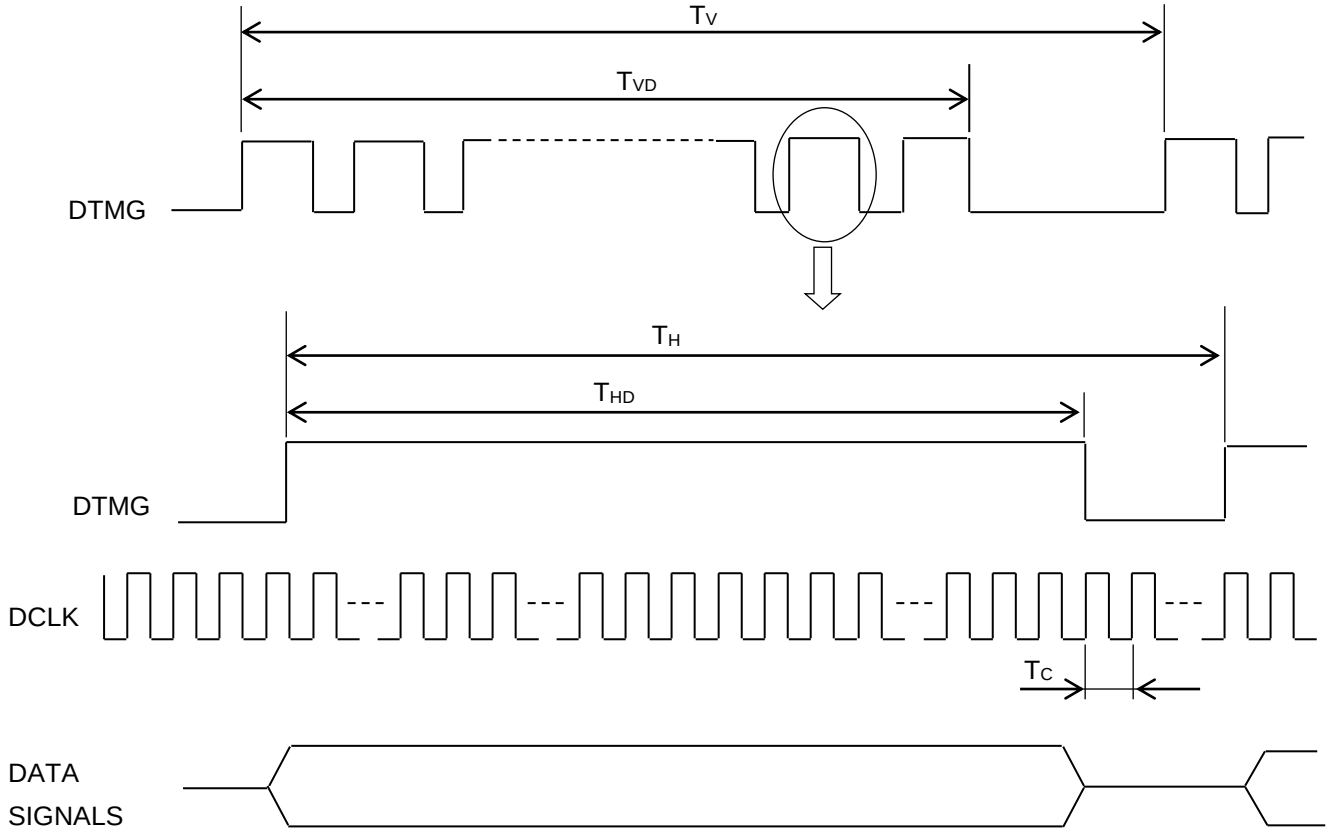
| Item | | Symbol | Min. | Typ. | | Max. | Unit |
|---|---|---|---|---|---|---|---|
| DCLK | FREQUENCY | 1/tc | 25.0 | 28.0 1) | 33.3 2) | 35.0 | MHz |
| RinX (X=0,1,2) | 0 data position | $t_{RP0}$ | $1/7t_{CLK}$-0.65 | $1/7*t_{CLK}$ | | $1/7t_{CLK}$+0.65 | ns |
| | 1st data position | $t_{RP1}$ | -0.65 | 0 | | -0.65 | |
| | 2nd data position | $t_{RP2}$ | $6/7t_{CLK}$-0.65 | $6/7*t_{CLK}$ | | $6/7t_{CLK}$+0.65 | |
| | 3rd data position | $t_{RP3}$ | $5/7t_{CLK}$-0.65 | $5/7*t_{CLK}$ | | $5/7t_{CLK}$+0.65 | |
| | 4th data position | $t_{RP4}$ | $4/7t_{CLK}$-0.65 | $4/7*t_{CLK}$ | | $4/7t_{CLK}$+0.65 | |
| | 5th data position | $t_{RP5}$ | $3/7t_{CLK}$-0.65 | $3/7*t_{CLK}$ | | $3/7t_{CLK}$+0.65 | |
| | 6th data position | $t_{RP6}$ | $2/7t_{CLK}$-0.65 | $2/7*t_{CLK}$ | | $2/7t_{CLK}$+0.65 | |

Note 1: $f_{Frame}$=50Hz

Note 2: $f_{Frame}$=60Hz

(2) Timing converter timing

(Input timing for transmitter)

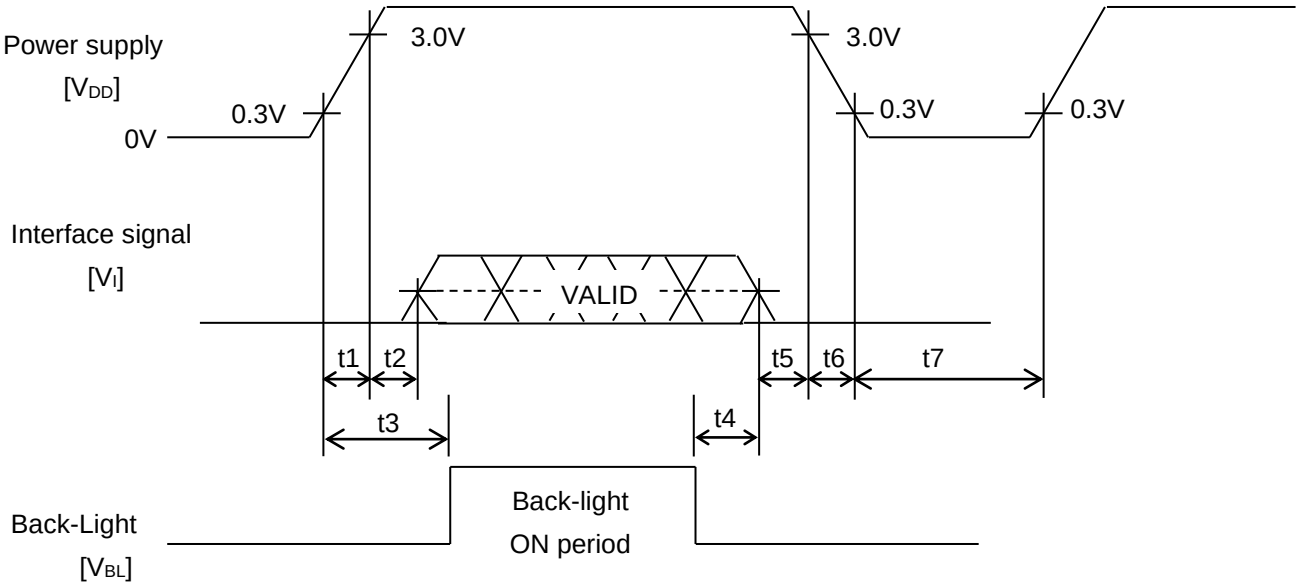



The timings except mentioned above are referred to the specifications of your transmitter.

| Item | | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|---|---|---|---|---|---|---|---|
| DCLK | Cycle time | $T_C$ | 28.6 | 30.0 | 40.0 | ns | |
| | Duty | D | 0.45 | 0.5 | 0.55 | - | |
| Horizontal | Horizontal period | $T_H$ | 845 | 1056 | 1500 | $T_C$ | |
| | Horizontal width-Active | $T_{HD}$ | 800 | 800 | 800 | $T_C$ | |
| Vertical | Vertical period | $T_V$ | 483 | 525 | 640 | $T_H$ | |
| | Vertical width-Active | $T_{VD}$ | 480 | 480 | 480 | $T_H$ | |
| | Frame frequency | $f_V$ | 42 | 60 | 75 | $H_Z$ | |

(3) Timing between interface signal and power supply

Power Supply, Input Signal and Backlight Voltage should comply with the following sequence.




| POWER ON | POWER OFF |
|---|---|
| 0< t1≦15ms | 5ms≦ t4 |
| 0< t2 ≦45ms | 0≦ t5 ≦45ms |
| 100ms≦t3 | 0≦ t6 ≦20ms |
| | 500ms≦t7 |

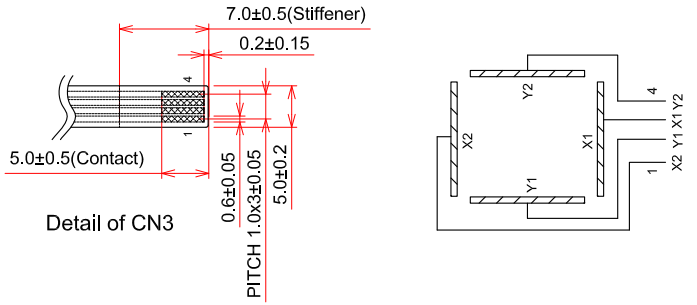
Note 1: In order to prevent electronic parts from destruction caused by latch-up, please input signal after power supply voltage on. in addition, please turn off signals before power supply voltage off.

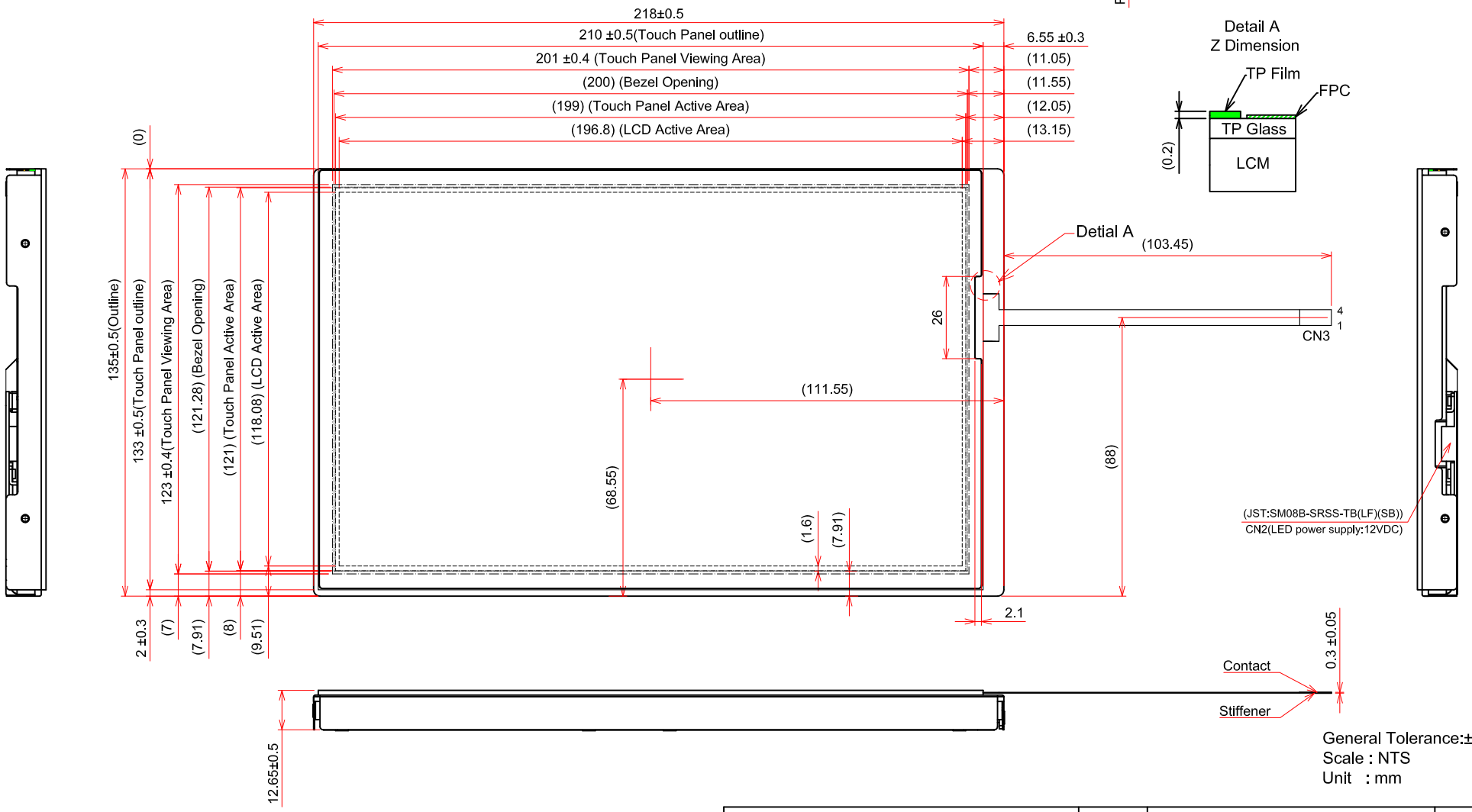
Note 2: In order to prevent from function error due to residual charge, please reenter power supply voltage after time stipulated with t7.

Note 3: Please turn on backlight after signals fix and turn off before signals down, otherwise noise appears in the display. The noise cause no problem with display performance in case of timing sequence comply with the spec.

# 10. OUTLINE DIMENSIONS

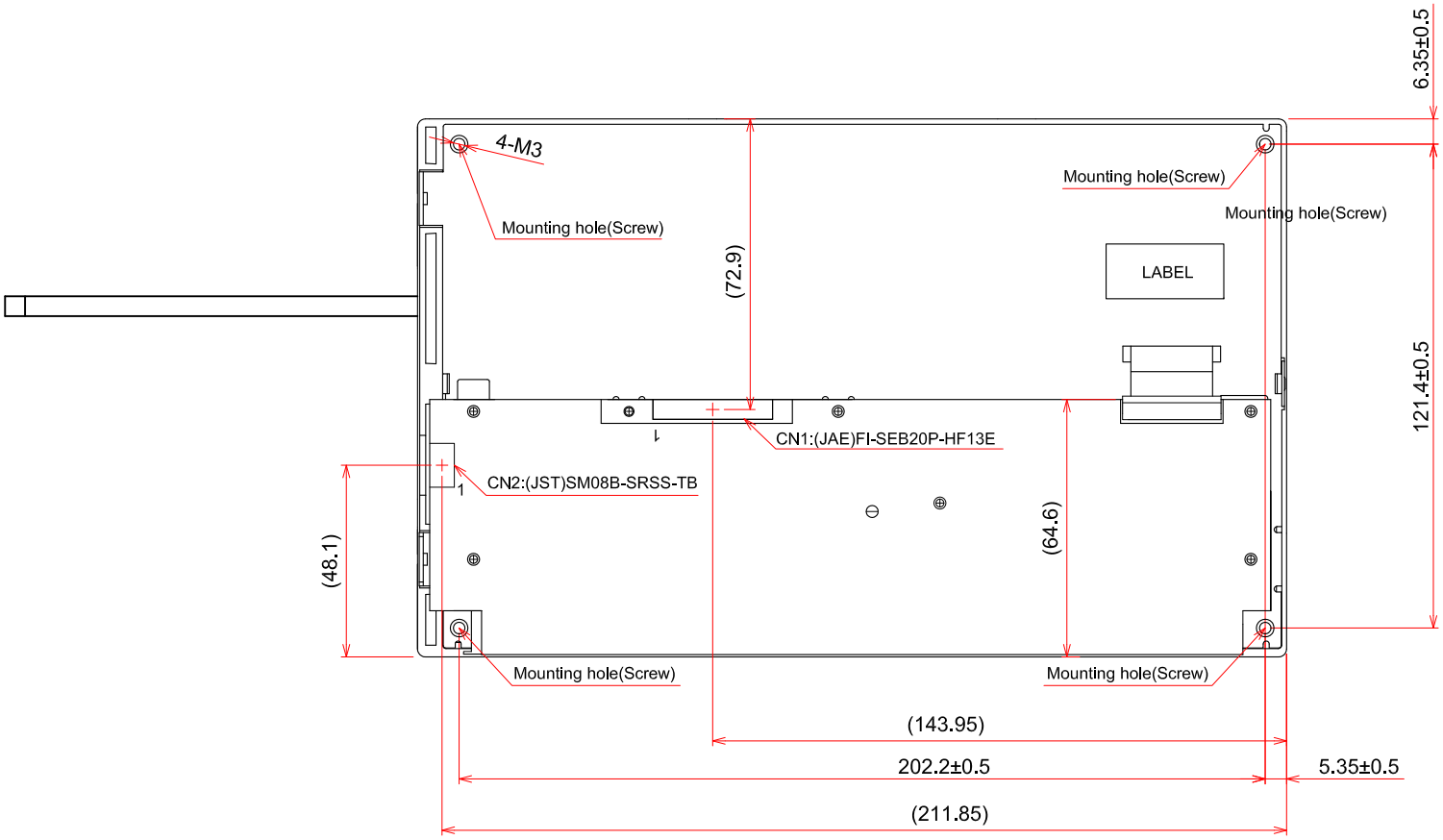
## 10.1 FRONT VIEW




General Tolerance:±0.5mm
Scale : NTS
Unit : mm

## 10.2 REAR VIEW




Note 1: Maximum length of screw for the mounting hole is 3.3mm

General Tolerance:±0.5mm
Scale : NTS
Unit : mm

| KAOHSIUNG OPTO-ELECTRONICS INC. | SHEET No. | 7B64PS 2710-TX23D203VM0BPA-2 | PAGE | 10-2/2 |
|---|---|---|---|---|

# 11. TOUCH PANEL

The type of touch panel used on this display is resistive, analog, 4-wire and film on glass, and more characteristics are shown as below:

## 11.1 OPERATING CONDITIONS

| Item | Specification | Remarks |
|---|---|---|
| Operating Voltage | DC 5V | DC 7V Max. |
| Operating Current | 20mA | - |

## 11.2 ELECTRICAL CHARACTERISTICS

| Item | | Specification | Remarks |
|---|---|---|---|
| Circuit resistance | X-axis | 310~1400 Ω | - |
| | Y-axis | 100~800 Ω | |
| Insulation Resistance | X-Y | >20M Ω | At DC 25V |
| Linearity | X | ≤ ± 1.5% | Note 1 |
| | Y | ≤ ± 1.5% | |
| Chattering | | ≤ 10ms | - |

Note 1: The test conditions and equipments of linearity are as below:

- Material of pen: poly-acetal resin
- End shape: R 0.8 mm
- Test force: 150 gf
- Pitch: 10 mm
- Test area is shown in Fig. 11.1

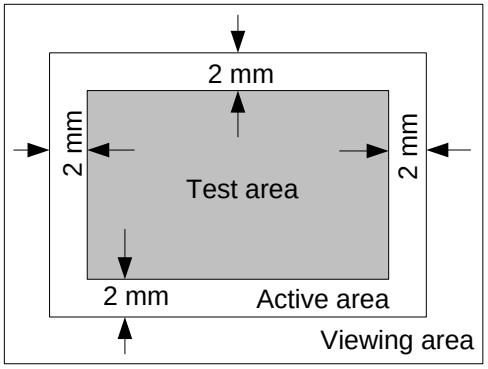



Fig. 11.1

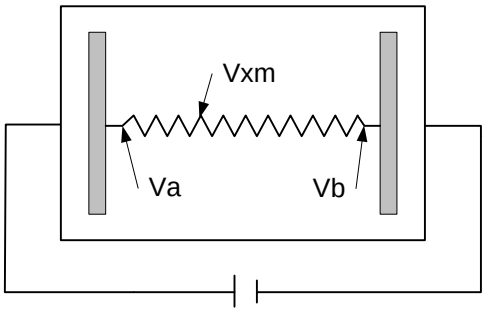



Fig. 11.2

As shown in Fig. 11.2, applying voltage meter to measure Va, Vb and Vxm, where Va is the maximum voltage in the active area; Vb is the minimum voltage in the active area; Vxm is the measured voltage of point x selected by random. Afterwards, the linearity can be calculated by following equation:

$$Linearity = \frac{|Vxi - Vxm|}{Va - Vb} \times 100\%,$$

where Vxi is the idea voltage of point x.

The method to measure the linearity of Y-axis is the same as above.

## 11.3 MECHANICAL CHARACTERISTICS

| Item | | Specification | Remarks |
|---|---|---|---|
| Activation force | Finger | 1.2N Max | End shape: R8.0 mm |
| | Pen | 1.2N Max | End shape: R0.8 mm |
| Surface Hardness | | 3H | JIS K 5400 |

## 11.4 OPTICAL CHARACTERISTICS

| Item | Specification | Remarks |
|---|---|---|
| Transmittance | >77% | - |

## 11.5 SAFETY AND ATTENTIONS

1) Do not put heavy shock or stress on the touch panel.

2) Please use soft cloth or absorbent cotton with ethanol to clean the touch panel by gently wiping. Moreover, please wipe it by horizontal or vertical direction instead of circling to prevent leaving scars on the touch panel's surface.

3) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean the display's surface.

4) UV protection is recommended to avoid the possibility of performance degrading when touch panel is likely applied under UV environment for a long period of time.

# 12. APPEARANCE STANDARD

The appearance inspection is performed in a dark room around 500~1000 lx based on the conditions as below:

- The distance between inspector's eyes and display is 30 cm.
- The viewing zone is defined with angle $\theta$ shown in Fig. 12.1 The inspection should be performed within 45° when display is shut down. The inspection should be performed within 5° when display is power on.

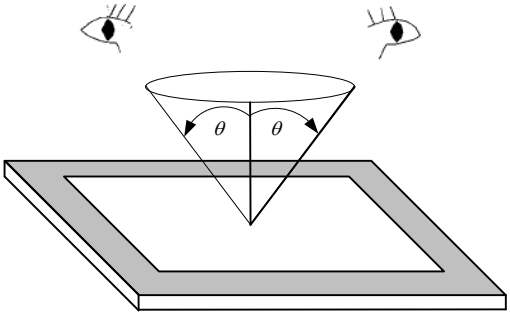



Fig. 12.1

## 12.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 3 areas as shown in Fig.12.2 for appearance specification in next section. A zone is the LCD active area (dot area); B zone is the area, which extended 1 mm out from LCD active area; C zone is the area between B zone and metal frame.

In terms of housing design, B zone is the recommended window area customers' housing should be located in.

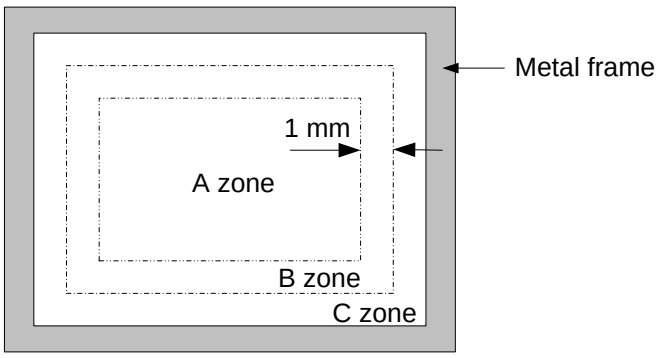



Fig. 12.2

## 12.2 LCD APPEARANCE SPECIFICATION

The specification as below is defined as the amount of unexpected phenomenon or material in different zones of LCD panel. The definitions of length, width and average diameter using in the table are shown in Fig. 12.3 and Fig. 12.4.

| Item | Criteria | | | | Applied zone |
|---|---|---|---|---|---|
| Scratches | Length (mm) | Width (mm) | Maximum number | Minimum space | A, B |
| | Ignored | W≦0.01 | Ignored | - | |
| | L≦40 | 0.01＜W≦0.02 | 10 | - | |
| | L≦20 | 0.02＜W≦0.04 | 10 | - | |
| | - | W＞0.04 | 0 | | |
| | Average diameter (mm) | | Maximum number | | |
| | D≦0.2 | | Ignored | | |
| | 0.2＜D≦0.4 | | 10 | | |
| | D＞0.4 | | 0 | | |
| Dent | Serious one is not allowed | | | | A |
| Wrinkles in polarizer | Serious one is not allowed | | | | A |
| Bubbles on polarizer | Average diameter (mm) | | Maximum number | | A |
| | D≦0.3 | | Ignored | | |
| | 0.3＜D≦0.5 | | 10 | | |
| | 0.5＜D≦1.0 | | 5 | | |
| | D＞1.0 | | 0 | | |
| 1) Stains<br>2) Foreign Materials<br>3) Dark Spot | Filamentous (Line shape) | | | | A, B |
| | Length (mm) | Width (mm) | Maximum number | | |
| | Ignored | W≦0.02 | Ignored | | |
| | L≦2.0 | 0.02＜W≦0.03 | 10 | | |
| | L≦1.0 | 0.03＜W≦0.06 | 10 | | |
| | - | W＞0.06 | 0 | | |
| | Round (Dot shape) | | | | A, B |
| | Average diameter (mm) | | Maximum number | | |
| | D≦0.2 | | Ignored | | |
| | 0.2＜D≦0.35 | | 5 | | |
| | D＞0.35 | | 0 | | |
| | Those wiped out easily are acceptable | | | | |
| Dot-Defect<br>(Note 1) | | Type | Maximum number | | A |
| | Bright dot-defect | 1 dot | 0 | | |
| | Dark dot-defect | 1 dot | 3 | | |
| | | 2 adjacent dot | 2 | | |
| | | 3 adjacent dot or above | Not allowed | | |
| | | In total | 5 | | |
| | In total | | 5 | | |

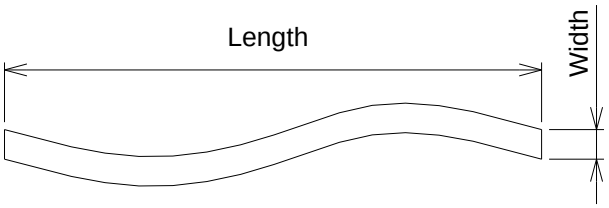



Fig 12.3

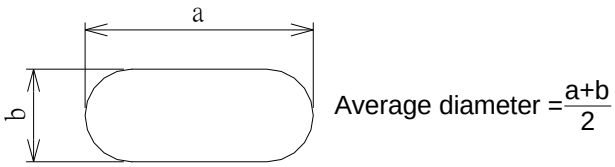



Fig 12.4

Note 1: The definitions of dot defect are as below:

- For bright dot-defect, showing black pattern, visible with 5% ND filter is defined.
- For dark dot-defect, showing white pattern, defect size over 1/2 dot area is defined.
- The definition of 1-dot-defect is the defect-dot, which is isolated and no adjacent defect-dot.
- The definition of adjacent dot is shown as Fig. 12.5.
- The Density of dot defect is defined in the area within diameter $\phi$ =10mm.

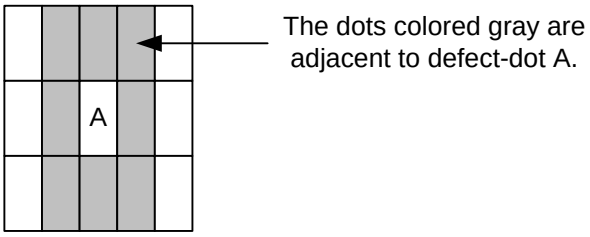


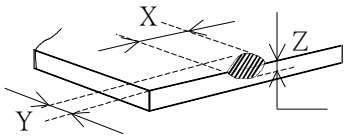
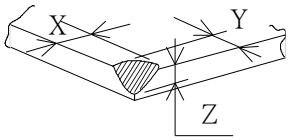
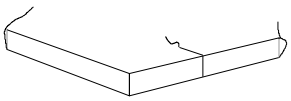

Fig. 12.5

## 12.3 TOUCH PANEL APPEARANCE SPECIFICATION

The specification as below is defined by the amount of unexpected material in different zones of touch panel.

| Item | Criteria | | | Applied zone |
|---|---|---|---|---|
| Scratches | Width (mm) | Length (mm) | Maximum number | A, B |
| | W＞0.1 | L≧10 | Not allowed | |
| | 0.10＞W≧0.05 | L＜10 | 4 pcs max. | |
| | 0.05≧W | L＜10 | Ignored | |
| Foreign Materials | Filamentous (Line shape) | | | A, B |
| | Width (mm) | Length (mm) | Maximum number | |
| | W＞0.10 | - | Dust (circular) | |
| | 0.10≧W＞0.05 | 3＜L | Not allowed | |
| | 0.05≧W | L≦3 | Ignored | |
| | Round (Dot shape) | | | A, B |
| | Average diameter (mm) | | Maximum number | |
| | D＞0.3 | | Not allowed | |
| | 0.3≧D＞0.2 | | 3 pcs max. | B |
| | D≦0.2 | | Ignored | A, B |

The limitation of glass flaw occurred on touch panel is defined in the table as below.

| Item | Specifications | |
|---|---|---|
| Edge flaw |  | X ≤ 5.0 mm<br>Y ≤ 1.0 mm<br>Z ≤ Thickness |
| Corner flaw |  | X ≤ 3.0 mm<br>Y ≤ 3.0 mm<br>Z ≤ Thickness |
| Progressive flaw |  | Not allowed |

# 13. PRECAUTIONS

## 13.1 PRECAUTIONS OF TOUCH PANEL

1) Please refer to Fig. 13.1 for housing the display with touch panel into applications. The Fig. 13.1 shows some points as below:

- The cushion needs to be designed between housing and touch panel in order to avoid unexpected pressure to cause any wrong reactions, and the cushion should be located in the cushion area.

- The housing should not cover the active area of touch panel as the figure shown.

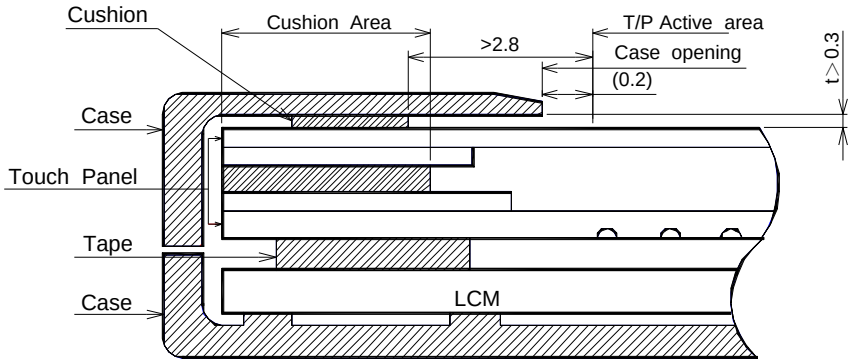



Fig. 13.1

## 13.2 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.

## 13.3 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 using sharp tools harder than 3H, especially touch panel, metal frame and polarizer.

2) Please do not stack the displays as this may damage the surface. In order to avoid any injuries, please avoid touching the edge of the glass or metal frame and wore gloves during handling.

3) Touching the polarizer or terminal pins with bare hand should be avoided to prevent staining and poor electrical contact.

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 permanent damages.

7) Maximum pressure to the surface of the display must be less than $1{,}96 \times 10^4$ Pa. If the area of applied pressure is less than $1\ \mathrm{cm}^2$, the maximum pressure must be less than 1.96N.

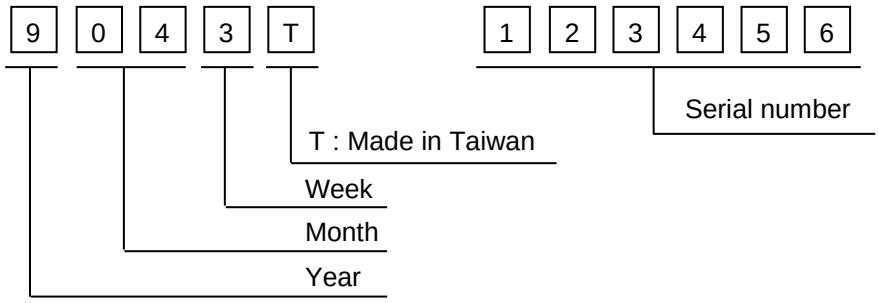
## 13.4 PRECAUTIONS OF STORAGE

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℃~35℃ 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.

# 14. DESIGNATION of LOT MARK

1) The lot mark is showing in Fig.14.1. First 4 digits are used to represent production lot, T represented made in Taiwan, and the last 6 digits are the serial number.




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

| Year | Mark |
|---|---|
| 2021 | 1 |
| 2022 | 2 |
| 2023 | 3 |
| 2024 | 4 |
| 2025 | 5 |

| Month | Mark | Month | Mark |
|---|---|---|---|
| 1 | 01 | 7 | 07 |
| 2 | 02 | 8 | 08 |
| 3 | 03 | 9 | 09 |
| 4 | 04 | 10 | 10 |
| 5 | 05 | 11 | 11 |
| 6 | 06 | 12 | 12 |

| Week (Days) | Mark |
|---|---|
| 1~7 | 1 |
| 8~14 | 2 |
| 15~21 | 3 |
| 22~28 | 4 |
| 29~31 | 5 |

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

| REV No. | ITEM | REMARKS |
|---|---|---|
| A | - | - |
| B | Tcon IC change | PCN1031 |

4) The location of the lot mark is on the back of the display shown in Fig. 14.1.

Label example:

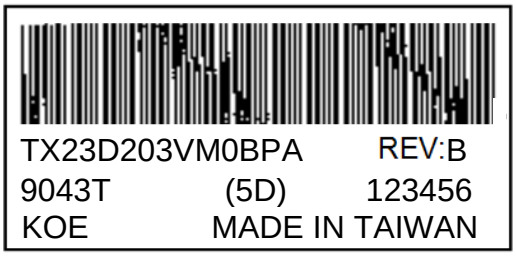



Fig 14.1