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 APOLLO DISPLAY
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Datasheet

KOE

TX13D204VM0BAA

KO-01-011

KOE

JDI Group

TENTATIVE

Kaohsiung Opto-Electronics Inc.

FOR MESSRS : _____

DATE : Jun. 23th, 2021

TECHNICAL DATA

TX13D204VM0BAA

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ACCEPTED BY : _____

PROPOSED BY : Oblack Tsai

2. RECORD OF REVISION

| DATE | SHEET No. | SUMMARY | | | | | | | | | |
|----------------------|---|---|--|----------------------|---|-------------------|--------------------------------|----------------------|---|-------------------|--------------------------------|
| Jun.23,'21 | 7B64LTD-2695-2 Page 3-1/1 | 3.1 DISPLAY FEATURES Revised : <table border="1" data-bbox="598 331 1490 407"> <tr> <td>Power Supply Voltage</td> <td>3.3V for LCD driving ; 28.3 V for Backlight</td> </tr> <tr> <td>Power Consumption</td> <td>0.5 W for LCD ; 3.81 W for B/L</td> </tr> </table> <p style="text-align: center;">↓</p> <table border="1" data-bbox="598 448 1490 524"> <tr> <td>Power Supply Voltage</td> <td>3.3V for LCD driving ; 21 V for Backlight</td> </tr> <tr> <td>Power Consumption</td> <td>0.5 W for LCD ; 3.36 W for B/L</td> </tr> </table> | | Power Supply Voltage | 3.3V for LCD driving ; 28.3 V for Backlight | Power Consumption | 0.5 W for LCD ; 3.81 W for B/L | Power Supply Voltage | 3.3V for LCD driving ; 21 V for Backlight | Power Consumption | 0.5 W for LCD ; 3.36 W for B/L |
| Power Supply Voltage | 3.3V for LCD driving ; 28.3 V for Backlight | | | | | | | | | | |
| Power Consumption | 0.5 W for LCD ; 3.81 W for B/L | | | | | | | | | | |
| Power Supply Voltage | 3.3V for LCD driving ; 21 V for Backlight | | | | | | | | | | |
| Power Consumption | 0.5 W for LCD ; 3.36 W for B/L | | | | | | | | | | |
| | | | | | | | | | | | |

3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 5" 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 | TX13D204VM0BAA |
| Module Dimensions | 121.0(W)mm x 80.0(H)mm x 7.1(D)mm (W/O component & FPC) |
| LCD Active Area | 108.0(W)mm x 64.8(H)mm |
| Pixel Pitch | 0.135(W)mm x 0.135(H)mm |
| Resolution | 800x3(R,G,B)(W)x480(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 (8-bit RGB) |
| Backlight | Light Emitting Diode (LED) |
| Weight | 90 g (typ.) |
| Interface | 50pin LVDS |
| Power Supply Voltage | 3.3V for LCD driving ; 21 V for Backlight |
| Power Consumption | 0.5 W for LCD ; 3.36 W for B/L |
| Viewing Direction | Super Wide version |

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 | 4.0 | V | Note 1 |
| Operating Temperature | T _{op} | -30 | 85 | °C | Note 2 |
| Storage Temperature | T _{st} | -40 | 90 | °C | Note 2 |
| Backlight Input Voltage | V _{LED} | - | (TBD) | V | - |

Note 1: The rating is defined for the signal voltages of the interface such as DCLK, DE, and RGB data bus.

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

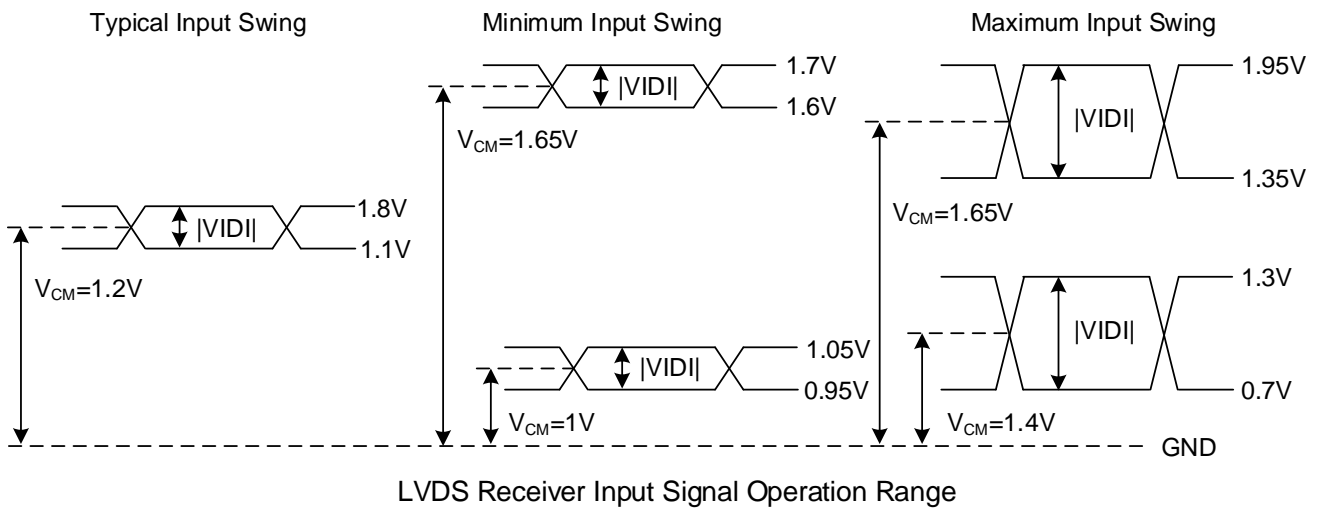
$T_a = 25^\circ\text{C}$, $V_{SS} = 0\text{V}$

| 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 | $0.7V_{DD}$ | - | V_{DD} | V | Note 1 |
| | | "L" level | 0 | - | $0.3V_{DD}$ | | |
| Power Supply Current | I_{DD} | $V_{DD}=3.3\text{V}$ | - | - | 150 | mA | Note 2 |
| Frame Frequency | f_{Frame} | - | 55 | 60 | 65 | Hz | - |
| CLK Frequency | f_{CLK} | - | 23.2 | 27.7 | 33.5 | MHz | - |

Note 1: The rating is defined for the signal voltages of the interface such as DE, DCLK and RGB data bus.

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

Note 3: VCM 1.2V is common mode voltage of LVDS transmitter and receiver.



5.2 BACKLIGHT CHARACTERISTICS

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

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remarks |
|---------------------|-----------|--------------------------------|------|------|------|------|---------|
| LED Input Voltage | V_{LED} | - | - | 21 | - | V | |
| LED Forward Current | I_{LED} | per LED | - | 80 | - | mA | |
| LED lifetime | - | $I_{LED}=80\text{ mA/per LED}$ | 30K | - | - | hrs | Note 1 |

Note 1: The estimated lifetime is specified as the time to reduce 50% brightness by applying 80 mA at 25°C .

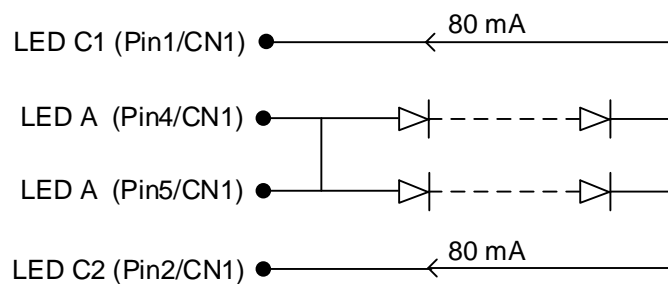


Fig 5.1

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 at least 15 minutes.
- The ambient temperature is 25 °C .
- In the dark room, the equipment has been set for the measurements as shown in Fig 6.1.

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

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remarks | |
|-------------------------------------|---------------|--|--|------|------|-------------------|---------|--------|
| Brightness of White | - | $\phi = 0^{\circ}, \theta = 0^{\circ}$, | 1000 | 1300 | - | cd/m ² | Note 1 | |
| Brightness Uniformity | - | $I_{LED}=80\text{ mA}$ | - | 70 | - | % | Note 2 | |
| Contrast Ratio | CR | (per LED) | 800 | 1300 | - | - | Note 3 | |
| Response Time (Rising + Falling) | $T_r + T_f$ | $\phi = 0^{\circ}, \theta = 0^{\circ}$ | - | - | 25 | ms | Note 4 | |
| NTSC Ratio | - | $\phi = 0^{\circ}, \theta = 0^{\circ}$ | - | 70 | - | % | - | |
| Viewing Angle | θ_x | $\phi = 0^{\circ}, CR \geq 10$ | - | 80 | - | Degree | Note 5 | |
| | $\theta_{x'}$ | $\phi = 180^{\circ}, CR \geq 10$ | - | 80 | - | | | |
| | θ_y | $\phi = 90^{\circ}, CR \geq 10$ | - | 80 | - | | | |
| | $\theta_{y'}$ | $\phi = 270^{\circ}, CR \geq 10$ | - | 80 | - | | | |
| Color Chromaticity | Red | X | $\phi = 0^{\circ}, \theta = 0^{\circ}$ | 0.60 | 0.64 | 0.68 | - | Note 6 |
| | | Y | | 0.29 | 0.33 | 0.37 | | |
| | Green | X | | 0.28 | 0.32 | 0.36 | | |
| | | Y | | 0.58 | 0.62 | 0.66 | | |
| | Blue | X | | 0.11 | 0.15 | 0.18 | | |
| | | Y | | 0.02 | 0.06 | 0.10 | | |
| | White | X | | 0.27 | 0.31 | 0.35 | | |
| | | Y | | 0.28 | 0.32 | 0.36 | | |

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 in active area measured by BM-5 as shown in Fig. 6.2.

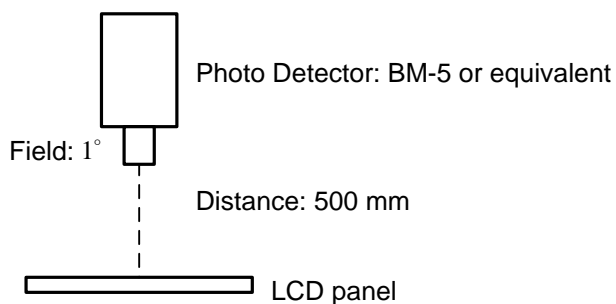


Fig 6.1

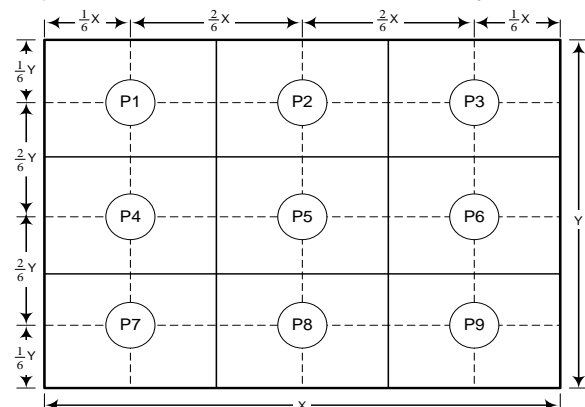


Fig 6.2

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.

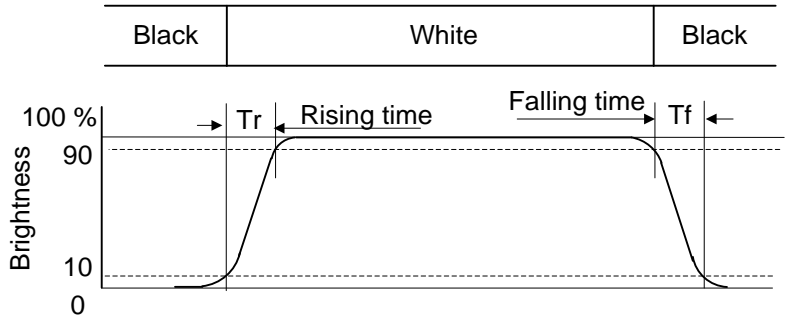


Fig 6.3

Note 5: The definition of viewing angle is shown in Fig. 6.4. Angle ϕ 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 θ 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.

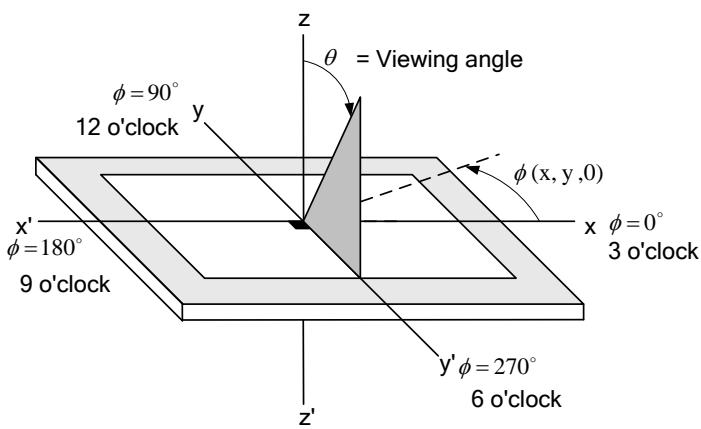
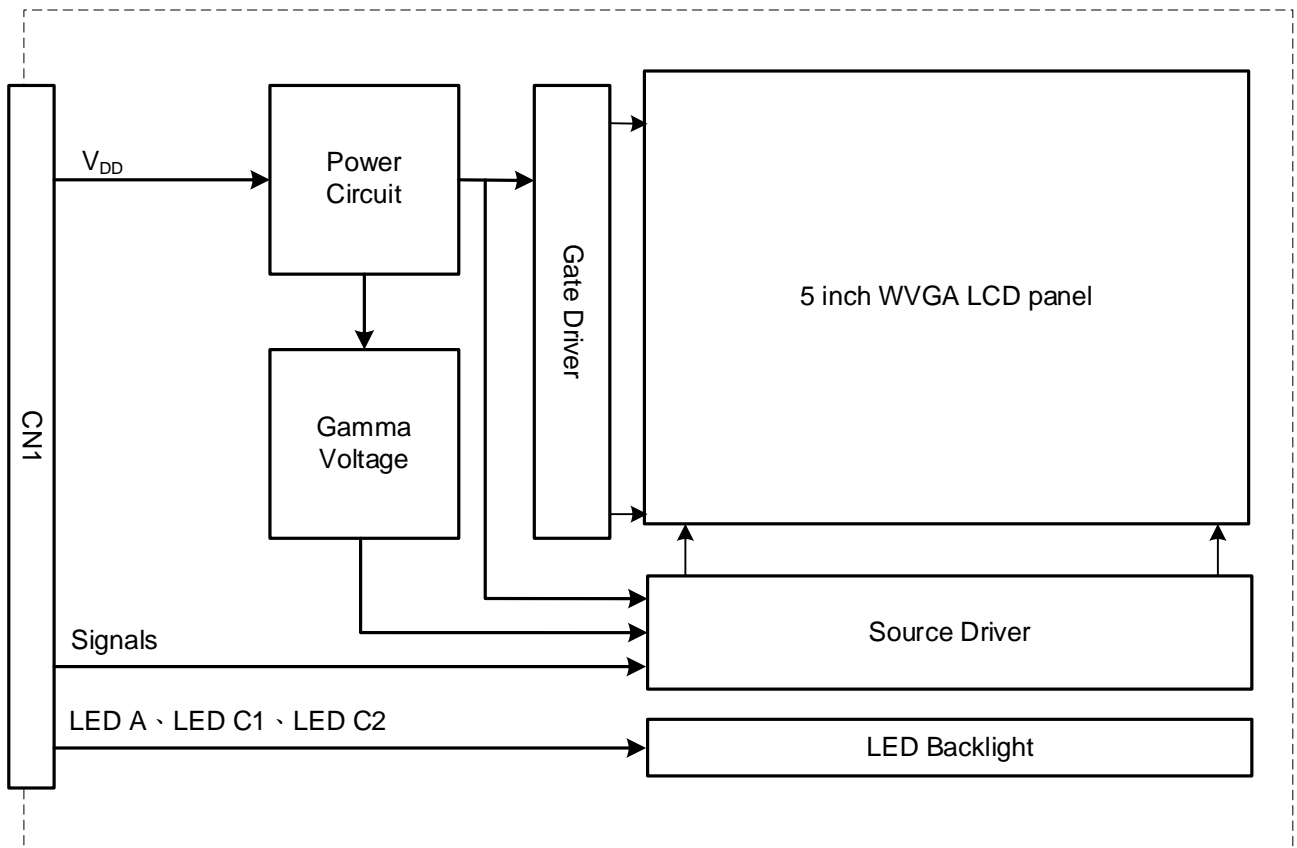


Fig 6.4

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 DCLK, DE, and RGB data bus.

8. LCD INTERFACE

8.1 INTERFACE PIN CONNECTIONS

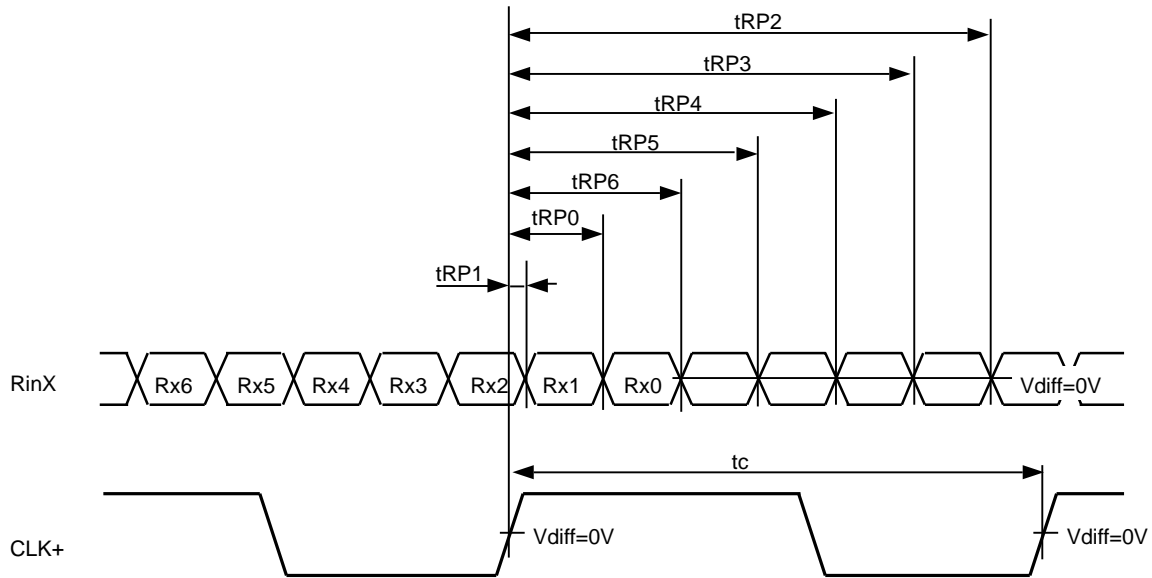
The display interface connector CN1 is pitch 0.5mm 50pin and pin assignment is as below:

| Pin No. | Symbol | Signal | Pin No. | Symbol | Signal |
|---------|-----------------|---------------|---------|-----------------|--|
| 1 | LED C1 | LED Cathode 1 | 26 | CLK IN- | Clock |
| 2 | LED C2 | LED Cathode 2 | 27 | V _{SS} | Ground |
| 3 | NC | No Connection | 28 | RST | Reset pin ("L" active) |
| 4 | LED A | LED Anode | 29 | STBYB | Standby mode setting pin ("H" Display ON ; "L Display OFF") |
| 5 | | | 30 | V _{SS} | Ground |
| 6 | NC | No Connection | 31 | L/R | Horizontal Display mode Control |
| 7 | V _{SS} | Ground | 32 | U/D | Vertical Display mode Control |
| 8 | | | 33 | V _{SS} | Ground |
| 9 | | | 34 | | |
| 10 | NC | No Connection | 35 | | |
| 11 | | | 36 | | |
| 12 | V _{SS} | Ground | 37 | | |
| 13 | IN3+ | Pixel Data | 38 | | |
| 14 | IN3- | | 39 | | |
| 15 | V _{SS} | Ground | 40 | | |
| 16 | IN2+ | Pixel Data | 41 | | |
| 17 | IN2- | | 42 | | |
| 18 | V _{SS} | Ground | 43 | | |
| 19 | IN1+ | Pixel Data | 44 | NC | No Connection |
| 20 | IN1- | | 45 | V _{DD} | Supply Voltage |
| 21 | V _{SS} | Ground | 46 | | |
| 22 | IN0+ | Pixel Data | 47 | | |
| 23 | IN0- | | 48 | NC | No Connection |
| 24 | V _{SS} | Ground | 49 | V _{SS} | Ground |
| 25 | CLK IN+ | Clock | 50 | | |

8.2 TIMING CHART

(1) LVDS Receiver Timing

(Interface of TFT module)



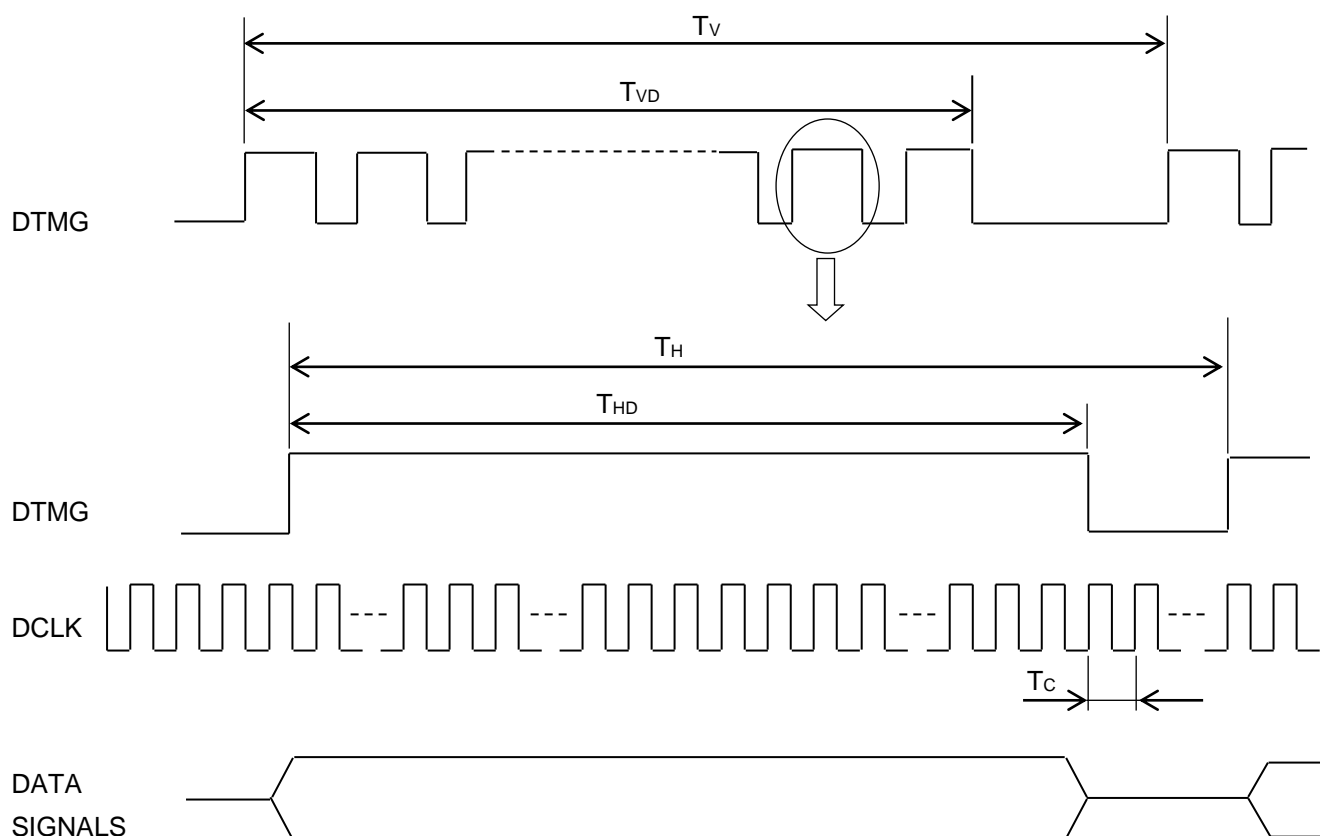
$$RinX = (RinX+) - (RinX-) \quad (X=0,1,2)$$

| Item | Symbol | Min. | Typ. | Max. | Unit | |
|-------------------|-------------------|-------------|------------------|---------------|------------------|-----|
| DCLK | FREQUENCY | $1/t_{CLK}$ | 23.2 | 27.7 1) | 33.5 | MHz |
| RinX (X=0,1,2) | 0 data position | t_{RP0} | $1/7t_{CLK}+0.8$ | $1/7*t_{CLK}$ | $1/7t_{CLK}+1.2$ | ns |
| | 1st data position | t_{RP1} | $1/7t_{CLK}-0.2$ | 0 | $1/7t_{CLK}+0.2$ | |
| | 2nd data position | t_{RP2} | $6/7t_{CLK}+5.8$ | $6/7*t_{CLK}$ | $6/7t_{CLK}+6.2$ | |
| | 3rd data position | t_{RP3} | $5/7t_{CLK}+4.8$ | $5/7*t_{CLK}$ | $5/7t_{CLK}+5.2$ | |
| | 4th data position | t_{RP4} | $4/7t_{CLK}+3.8$ | $4/7*t_{CLK}$ | $4/7t_{CLK}+4.2$ | |
| | 5th data position | t_{RP5} | $3/7t_{CLK}+2.8$ | $3/7*t_{CLK}$ | $3/7t_{CLK}+3.2$ | |
| | 6th data position | t_{RP6} | $2/7t_{CLK}+1.8$ | $2/7*t_{CLK}$ | $2/7t_{CLK}+2.2$ | |

Note 1: $f_v=60\text{Hz}$

(2) Timing converter timing

(Input timing for transmitter)

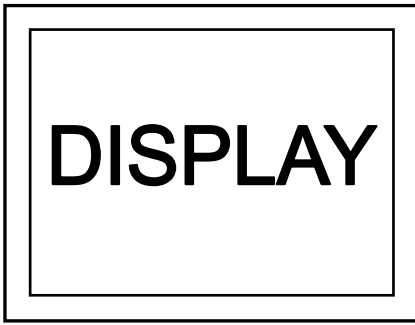


The timings except mentioned above are referred to the specifications of your transmitter.

| Item | | Symbol | Min. | Typ. | Max. | Unit | Remarks |
|------------|-------------------------|----------|------|------|------|-------|---------|
| DCLK | Cycle time | T_C | 29.9 | 36.1 | 43.1 | ns | |
| Horizontal | Horizontal period | T_H | 862 | 884 | 920 | T_C | |
| | Horizontal width-Active | T_{HD} | 800 | | | T_C | |
| Vertical | Vertical period | T_V | 490 | 523 | 560 | T_H | |
| | Vertical width-Active | T_{VD} | 480 | | | T_H | |
| | Frame frequency | f_v | 55 | 60 | 65 | Hz | |

8.3 SCAN DIRECTION

Scan direction is available to be switched as below:



L/R: H , U/D: H (Default)



L/R: L , U/D: H



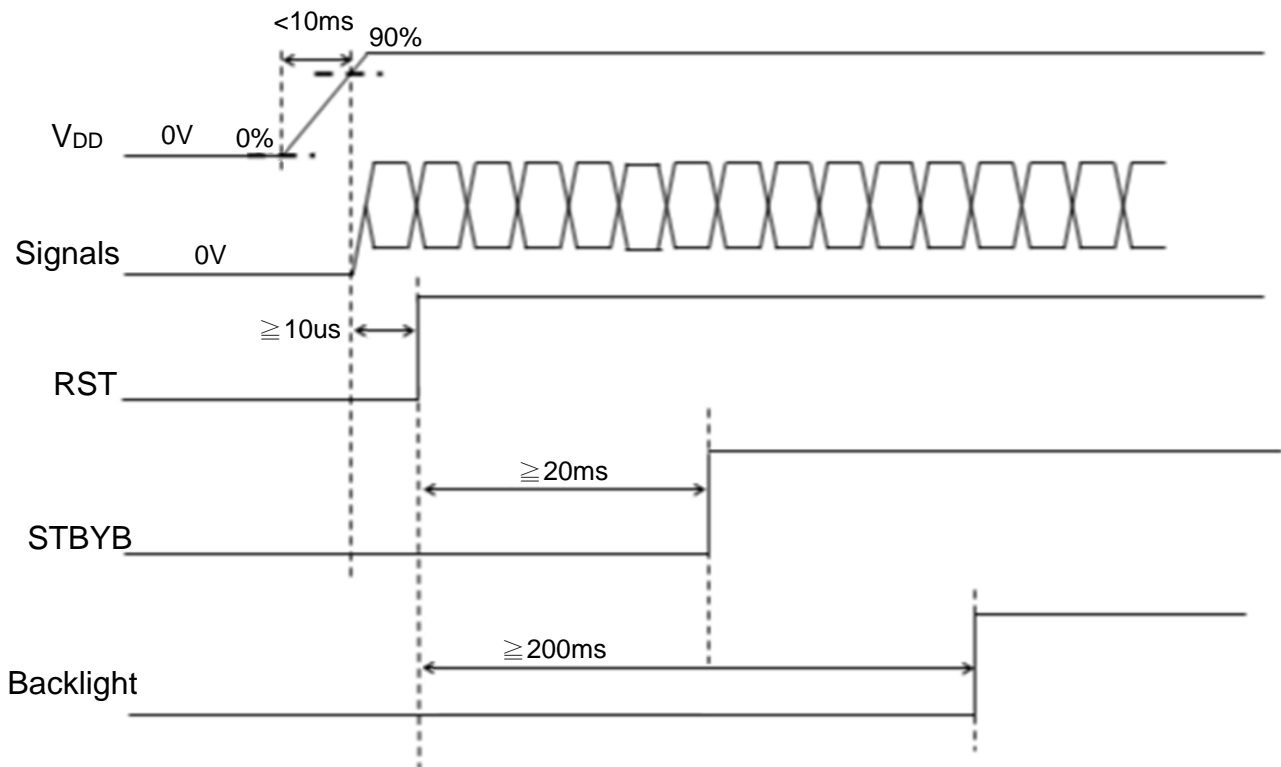
L/R: H , U/D: L



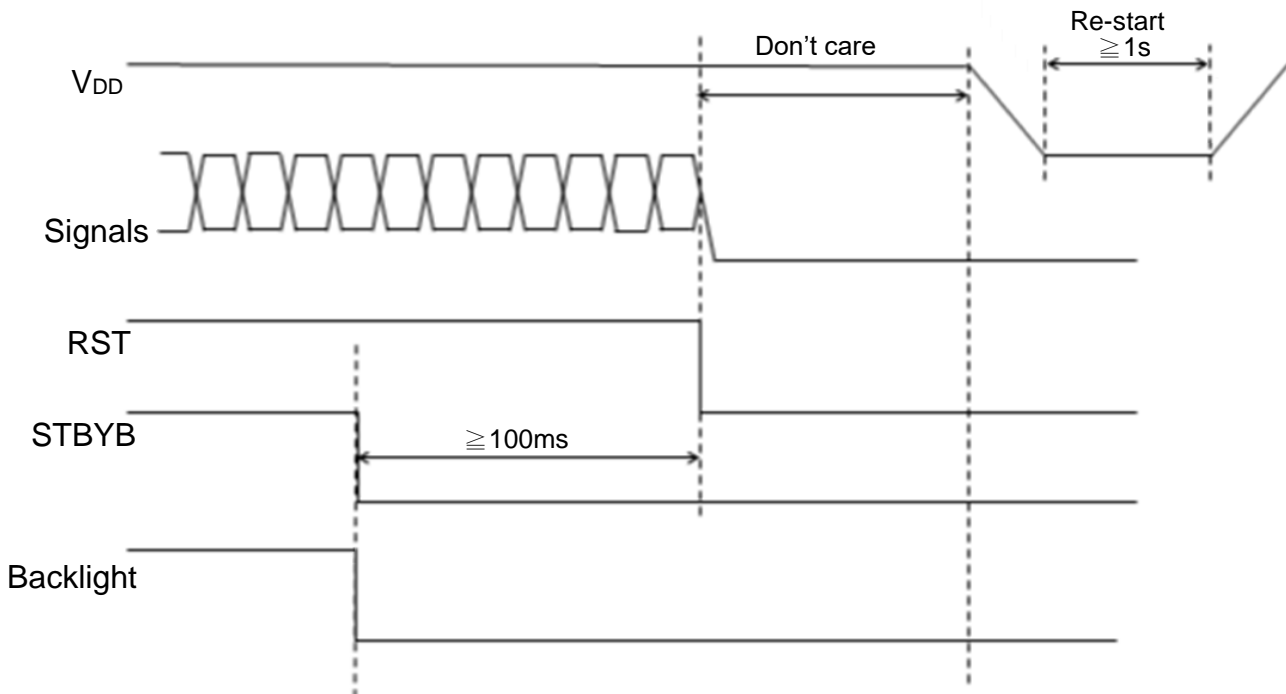
L/R: L , U/D: L

8.4 POWER SEQUENCE

Power ON



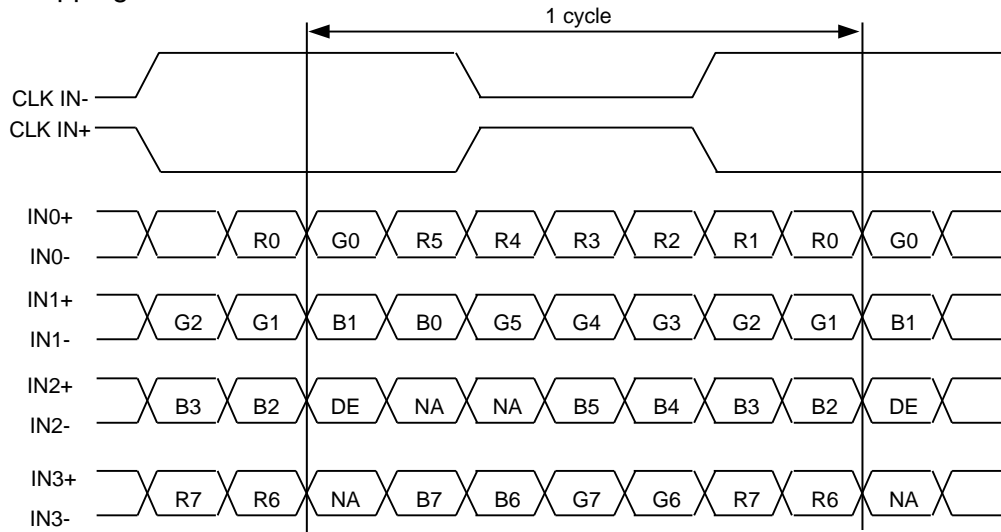
Power OFF



8.5 DATA INPUT for DISPLAY COLOR

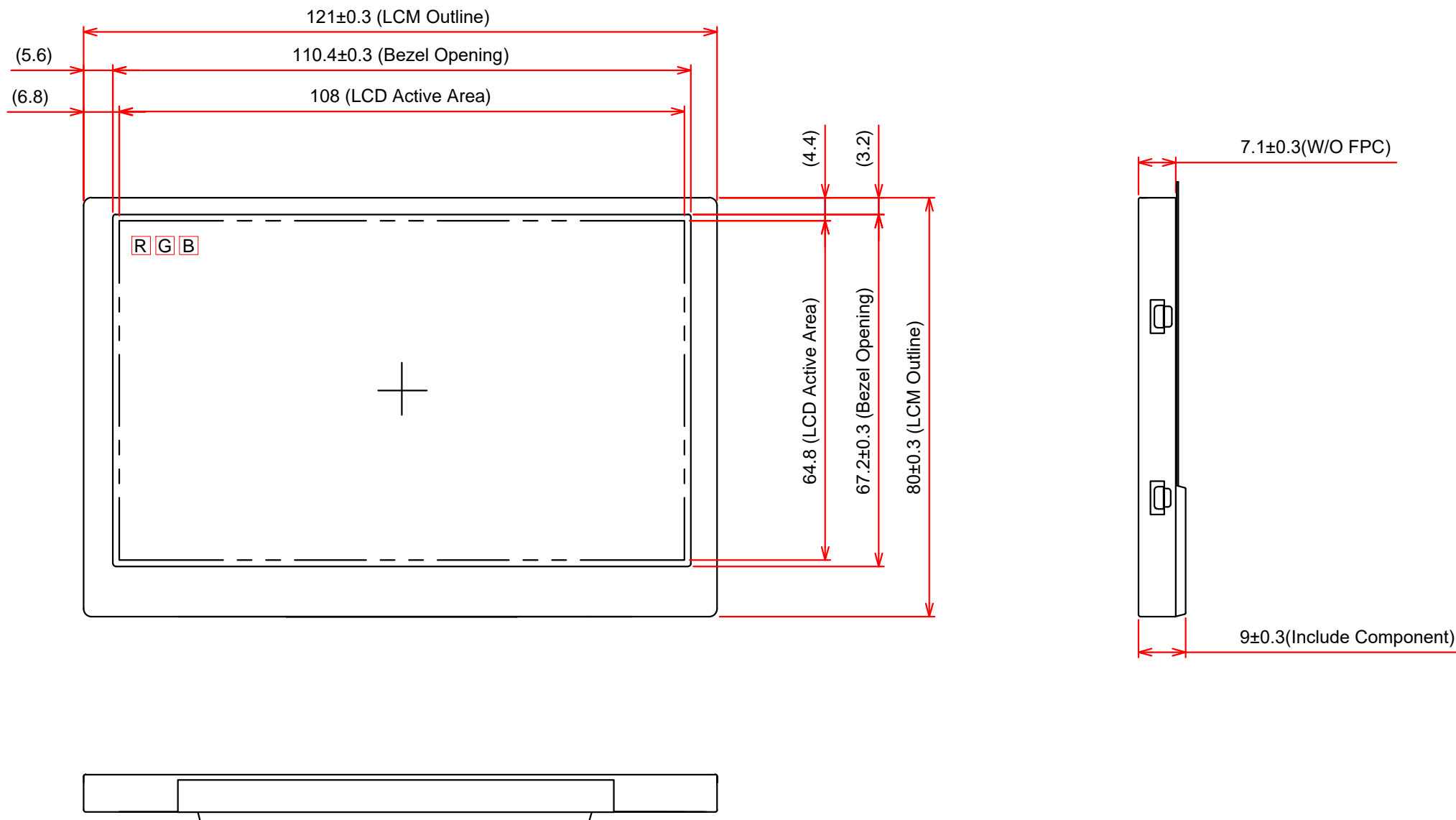
| Input color | | Red Data | | | | | | | | Green Data | | | | | | | | Blue Data | | | | | | | |
|-------------|------------|----------|----|----|----|----|----|----|-----|------------|----|----|----|----|----|----|-----|-----------|----|----|----|----|----|----|-----|
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| | | MSB | | | | | | | LSB | MSB | | | | | | | LSB | 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 | |
| | 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 | |
| | 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 | |
| | 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 | |
| | 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 | 0 | 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 | |
| | White | 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 | | |
| | 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 | | |
| Green | Black | 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 | 1 | 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 | | |
| | 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 | | |
| Blue | Black | 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 | 0 | | |
| | Blue(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |

(1) Data Mapping



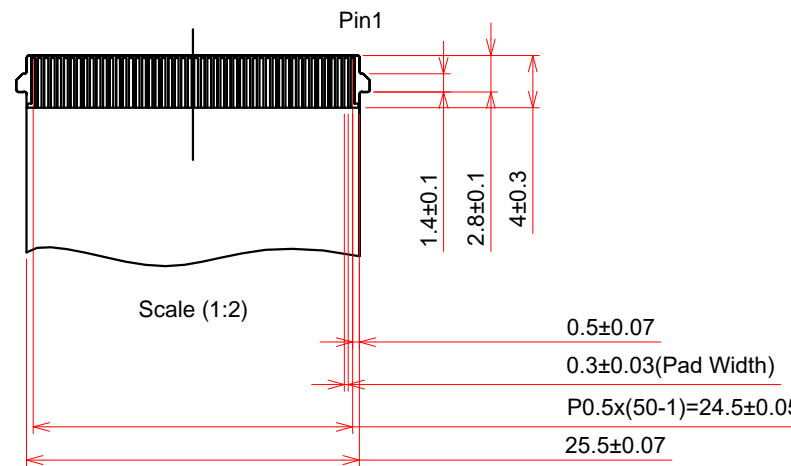
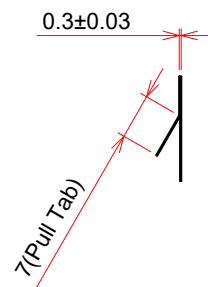
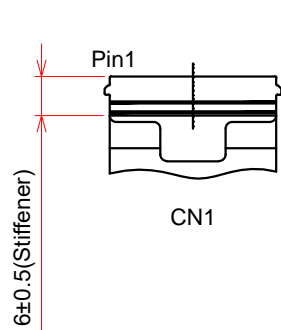
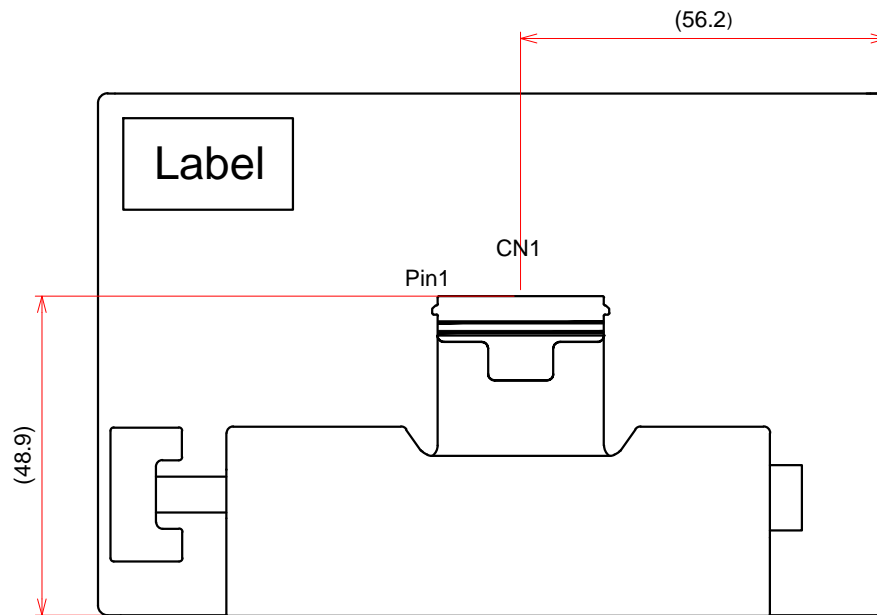
9. OUTLINE DIMENSIONS

9.1 FRONT VIEW



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

9.2 RAER VIEW



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

10. DESIGNATION of LOT MARK

1) The lot mark is showing in Fig.10.1. First 4 digits are used to represent production lot, T represented made in Taiwan, and the last 6 digits are the serial number.

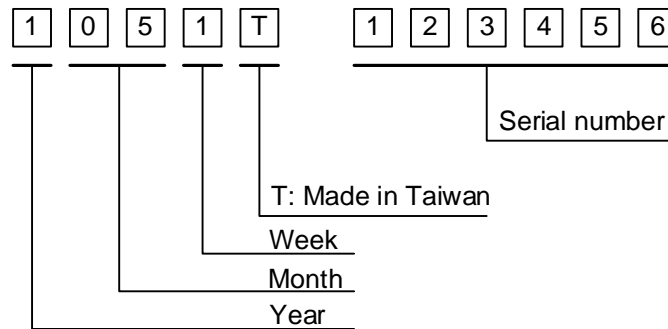


Fig. 10.1

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

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

| 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. 10.2.

Label example:

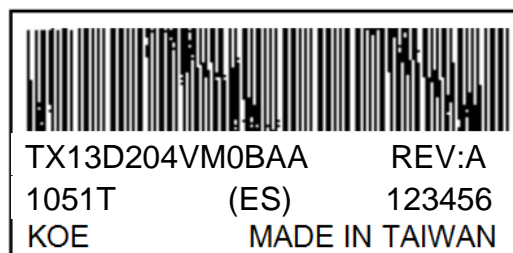


Fig. 10.2

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