

# HITACHI

KAOHSIUNG HITACHI ELECTRONICS CO., LTD.

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

DATE: Nov. 02<sup>th</sup> 2009

## CUSTOMER'S ACCEPTANCE SPECIFICATIONS

### TX23D38VM0CAA

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

PROPOSED BY:

Elton Liu

## 2. RECORD OF REVISION

| DATE | SHEET No. | SUMMARY |
|------|-----------|---------|
|      |           |         |

## 3. GENERAL DATA

### 3.1 DISPLAY FEATURES

This module is a 9" WVGA 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, and COF (chip on film) technology and LED backlight are applied on this display.

|                         |                                               |
|-------------------------|-----------------------------------------------|
| Part Name               | TX23D38VM0CAA                                 |
| Module Dimensions       | 218.0(W) mm x 135.0(H) mm x 11.15 (D) mm      |
| LCD Active Area         | 195.0(W) mm x 117.0(H) mm                     |
| Pixel Pitch             | 0.24375(W) mm x 0.24375(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               | 7 LEDs parallel x 3 serial (21 LEDs in total) |
| Weight                  | (330) g (typ.)                                |
| Interface               | 1ch-LVDS/Receiver ; 20 pins                   |
| Power Supply Voltage    | 3.3V for LCD; 12V for Backlight               |
| Power Consumption       | 1.5 W for LCD (WVGA) ;6.98W for backlight     |
| Viewing Direction       | Super Wide Version (In Plane Switching)       |

## 4. ABSOLUTE MAXIMUM RATINGS

| Item                    | Symbol | Min. | Max.    | Unit | Remarks |
|-------------------------|--------|------|---------|------|---------|
| Supply Voltage          | VDD    | 0    | 4.0     | V    | -       |
| Input Voltage of Logic  | VI     | -0.3 | VDD+0.3 | V    | Note 1  |
| Operating Temperature   | Top    | -20  | 70      | °C   | Note 2  |
| Storage Temperature     | Tst    | -30  | 80      | °C   | Note 2  |
| Backlight Input Voltage | VLED   | -    | 15      | V    | -       |

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

Note 2: The maximum rating is defined as above based on the temperature on the panel surface, 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<sub>a</sub> = 25 °C, VSS = 0V

| Item                                                   | Symbol           | Condition     | Min.   | Typ. | Max.   | Unit | Remarks    |
|--------------------------------------------------------|------------------|---------------|--------|------|--------|------|------------|
| Power Supply Voltage                                   | VDD              | -             | 3.0    | 3.3  | 3.6    | V    | -          |
| Differential Input Voltage for LVDS Receiver Threshold | VI               | "H" level     | -      | -    | +100   | mV   | Note 1     |
|                                                        |                  | "L" level     | -100   | -    | -      |      |            |
| DPS,FRC,AMODE Signal Input Voltage                     | VI               | "H" level     | 0.7VDD | -    | VDD    | V    | CMOS LEVEL |
|                                                        |                  | "L" level     | 0      | -    | 0.3VDD |      |            |
| Power Supply Current                                   | IDD              | VDD-VSS =3.3V | -      | 465  | 560    | mA   | Note 2,3   |
| Vsync Frequency                                        | f <sub>v</sub>   | -             | -      | 60   | 75     | Hz   | Note 4,5   |
| Hsync Frequency                                        | f <sub>H</sub>   | -             | -      | 31.3 | 39.4   | KHz  | Note 4     |
| DCLK Frequency                                         | f <sub>CLK</sub> | -             | -      | 33.3 | 35     | MHz  | Note 4     |

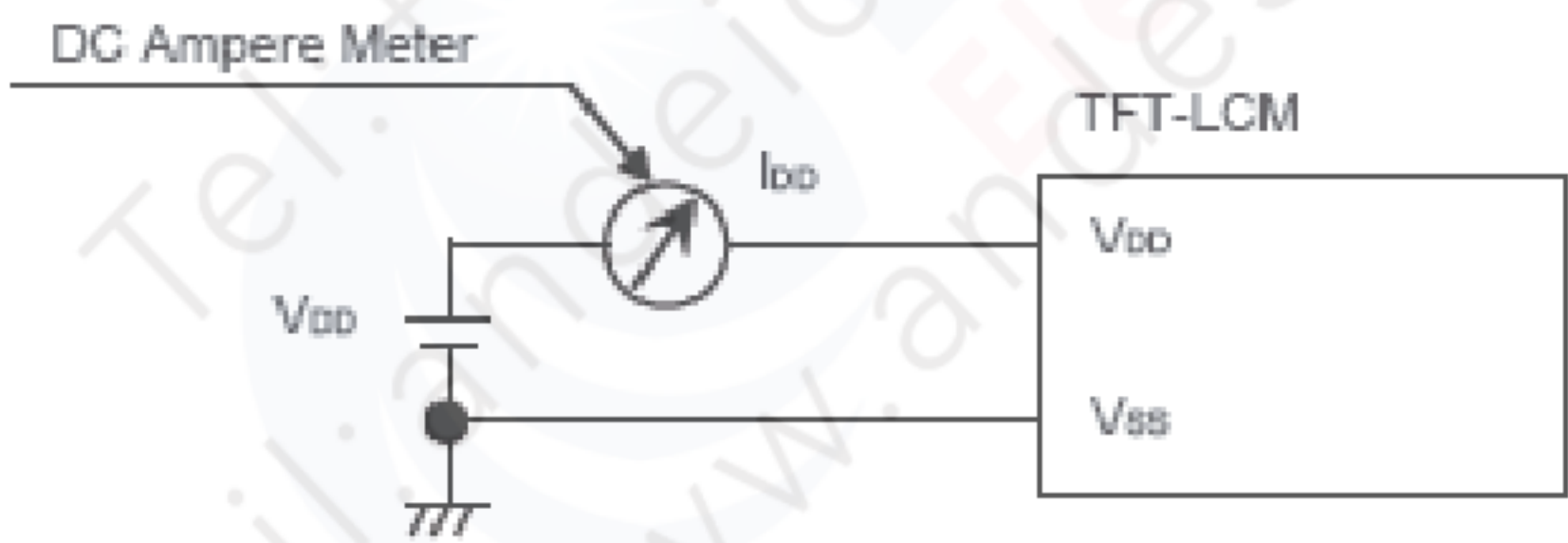
Notes 1 : VCM=VDD / 2V

VCM is common mode voltage of LVDS transmitter / receiver .The input terminal of LVDS transmitter is terminated with 100Ω.



Notes 2 : fV=60Hz,fCLK=35MHz,VDD=3.3V,DC Current.

Typical value is measured when displaying vertical 256 gray scale. Maximum is measured when displaying Vertical-stripe.



Notes 3 : As this module contains 1.0A fuse, prepare current source that is enough for cutting current fuse when a trouble happens. (larger than 2.5A)

Notes 4 : For LVDS Transmitter Input

Notes 5 : Vertical frequency is recommended to apply 60Hz.

5.2 BACKLIGHT CHARACTERISTICS

| Item                                 | Symbol | Condition         | Min. | Typ. | Max. | Unit | Remarks |
|--------------------------------------|--------|-------------------|------|------|------|------|---------|
| LED Input Voltage                    | VLED   | -                 | 11.7 | 12.0 | 12.3 | V    | Note1   |
| LED Forward Current<br>(Dim Control) | ILED   | 0V; 0% duty       | 540  | 580  | 620  | mA   | Note 2  |
|                                      |        | 3.3VDC; 100% duty | 15   | 30   | 45   |      |         |
| LED lifetime                         | -      | 580 mA            | -    | 70K  | -    | hrs  | Note 3  |

Note 1: As Fig. 5.1 shown, LED current is constant, 580 mA, controlled by the LED driver when applying 12V VLED.

Note 2: Dimming function can be obtained by applying DC voltage or PWM signal from the display interface CN1. The recommended PWM signal is 1K ~ 10K Hz with 3.3V amplitude.

Note 3: The estimated lifetime is specified as the time to reduce 50% brightness by applying 580 mA at 25°C .

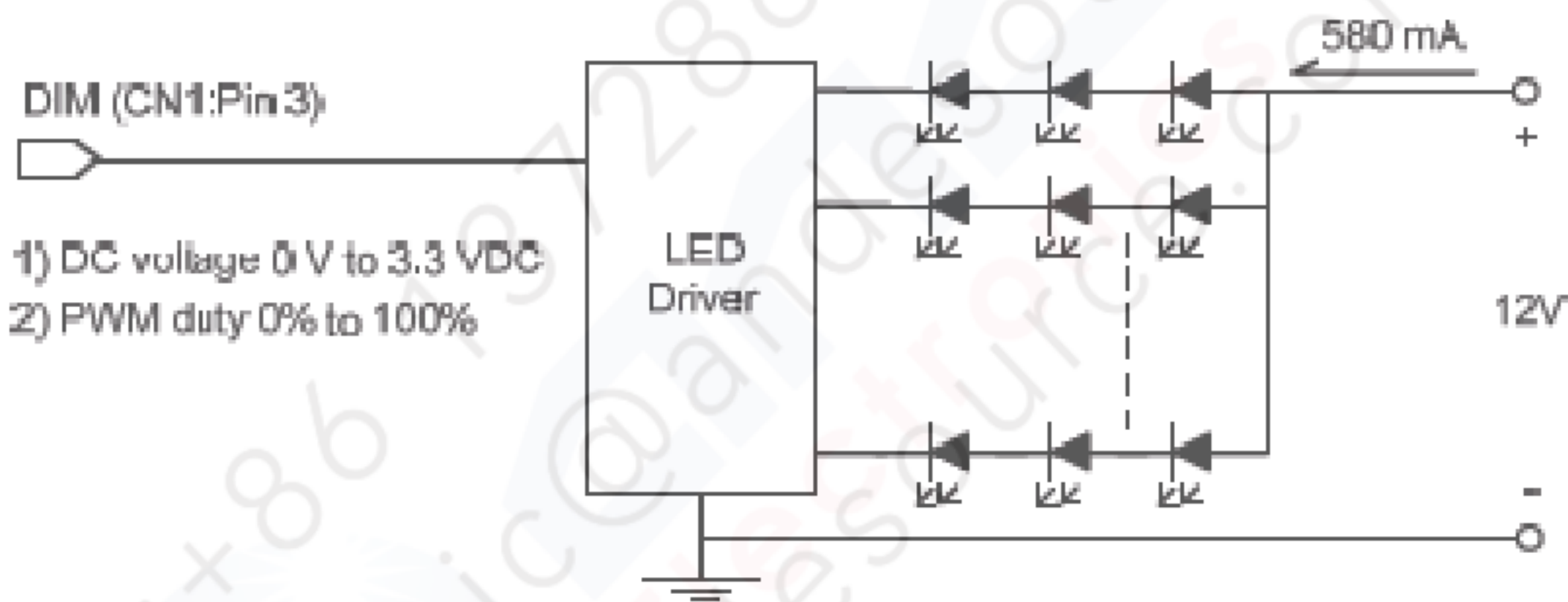


Fig. 5.1

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 for 30 minutes.
- The ambient temperature is 25°C.
- In the dark room around 500~1000 lx, the equipment has been set for the measurements as shown in Fig 6.1.

$T_a = 25\text{ }^{\circ}\text{C}, f_v = 60\text{ Hz}, VDD = 3.3\text{V}$

| Item                  |       | Symbol      | Condition                                              | Min. | Typ. | Max. | Unit              | Remarks |
|-----------------------|-------|-------------|--------------------------------------------------------|------|------|------|-------------------|---------|
| Brightness of White   |       | -           | $\phi = 0^{\circ}, \theta = 0^{\circ}$<br>ILED= 580 mA | 350  | 450  | -    | cd/m <sup>2</sup> | Note 1  |
| Brightness Uniformity |       | -           |                                                        | 75   | -    | -    | %                 | Note 2  |
| Contrast Ratio        |       | CR          |                                                        | 500  | 800  | -    | -                 | Note 3  |
| Response Time         |       | Rise + Fall | $\phi = 0^{\circ}, \theta = 0^{\circ}$                 | -    | 25   | 50   | ms                | Note 4  |
| NTSC Ratio            |       | -           | $\phi = 0^{\circ}, \theta = 0^{\circ}$                 | -    | 60   | -    | %                 | -       |
| Viewing Angle         |       | $\theta x$  | $\phi = 0^{\circ}, CR \geq 10$                         | -    | 85   | -    | Degree            | Note 5  |
|                       |       | $\theta x'$ | $\phi = 180^{\circ}, CR \geq 10$                       | -    | 85   | -    |                   |         |
|                       |       | $\theta y$  | $\phi = 90^{\circ}, CR \geq 10$                        | -    | 85   | -    |                   |         |
|                       |       | $\theta y'$ | $\phi = 270^{\circ}, CR \geq 10$                       | -    | 85   | -    |                   |         |
| Color Chromaticity    | Red   | X           | $\phi = 0^{\circ}, \theta = 0^{\circ}$                 | 0.59 | 0.64 | 0.69 | -                 | Note 6  |
|                       |       | Y           |                                                        | 0.29 | 0.34 | 0.39 |                   |         |
|                       | Green | X           |                                                        | 0.31 | 0.36 | 0.41 |                   |         |
|                       |       | Y           |                                                        | 0.55 | 0.60 | 0.65 |                   |         |
|                       | Blue  | X           |                                                        | 0.10 | 0.15 | 0.20 |                   |         |
|                       |       | Y           |                                                        | 0.01 | 0.06 | 0.11 |                   |         |
|                       | White | X           |                                                        | 0.30 | 0.35 | 0.40 |                   |         |
|                       |       | Y           |                                                        | 0.31 | 0.36 | 0.41 |                   |         |

Note 1: The brightness is measured from 9 point of the panel, P1~P9 in Fig. 6.2, for the average 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.

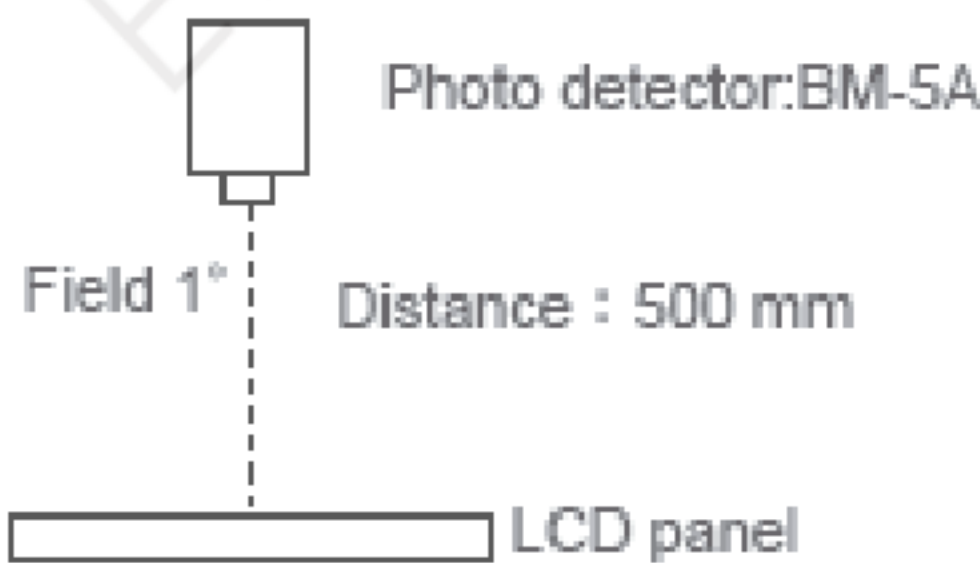


Fig. 6.1

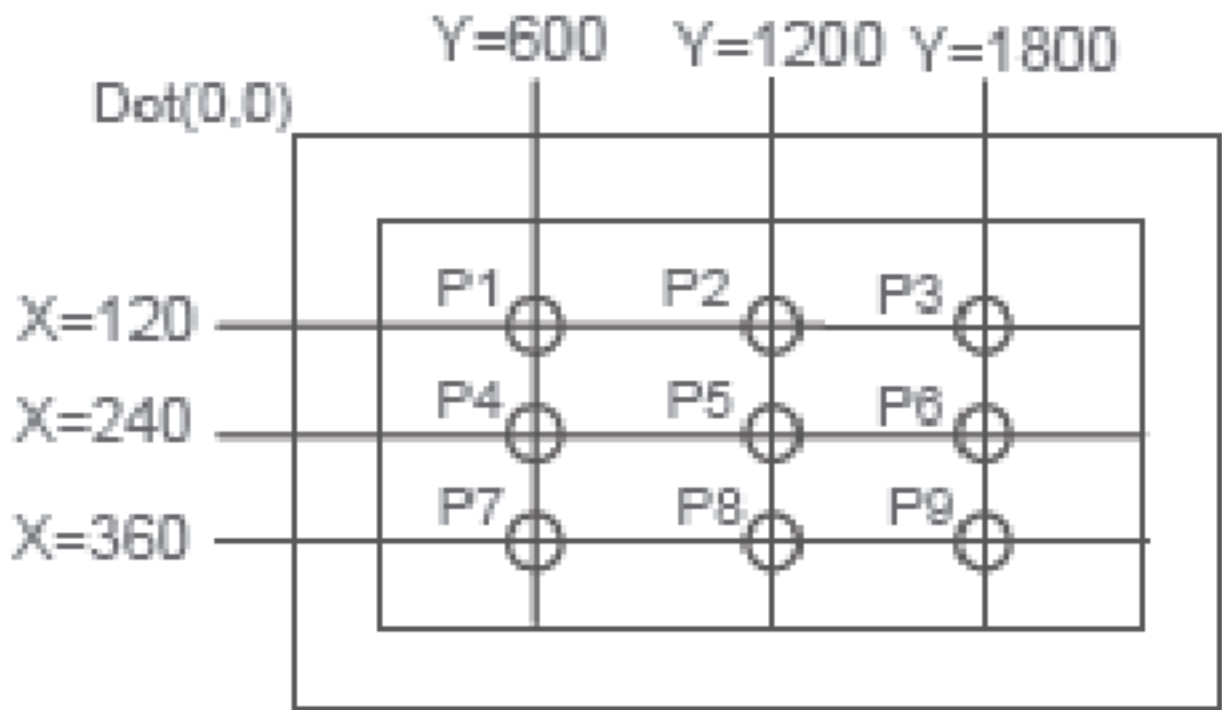


Fig. 6.2

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 white to black. Oppositely, Falling time is the period from 90% brightness rising to 10% brightness.

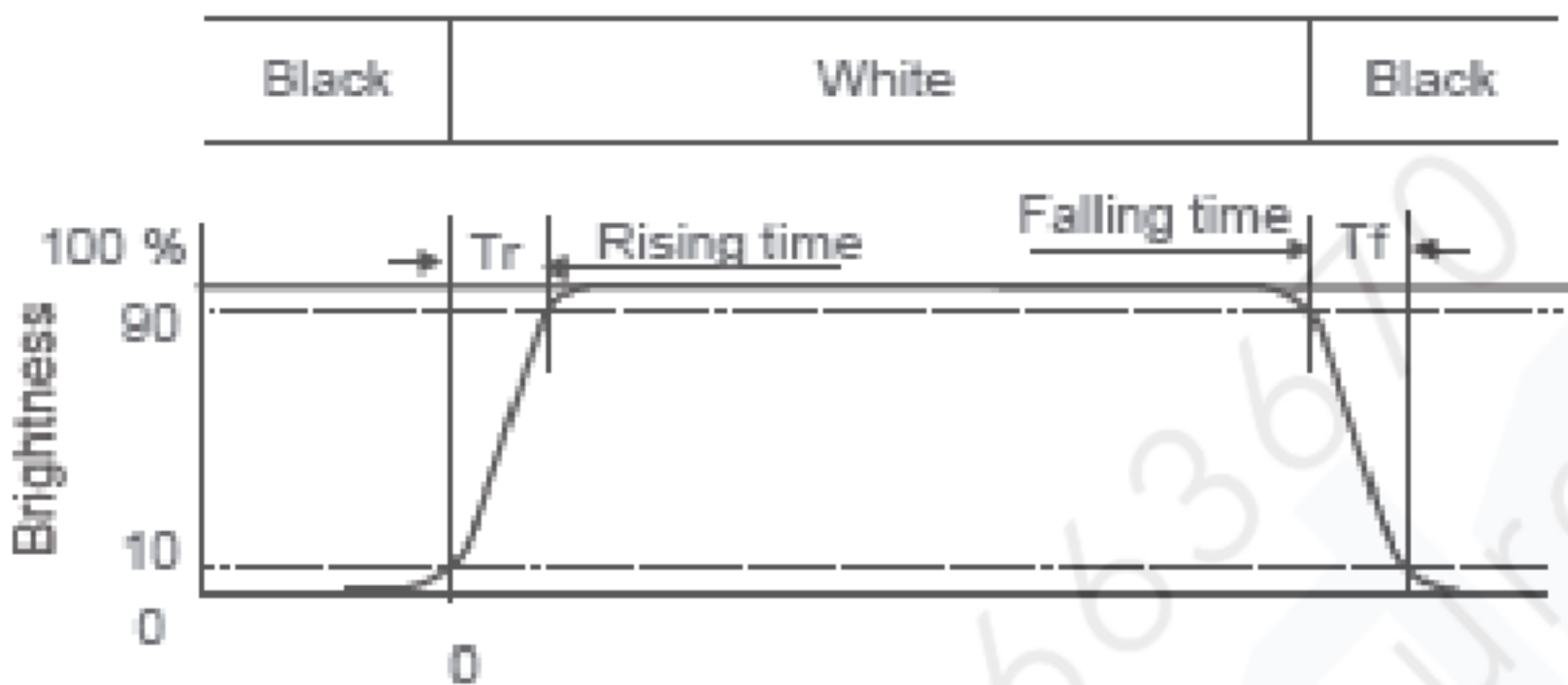


Fig . 6.3

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;  $85^\circ$  viewing angle can be obtained from each viewing direction.

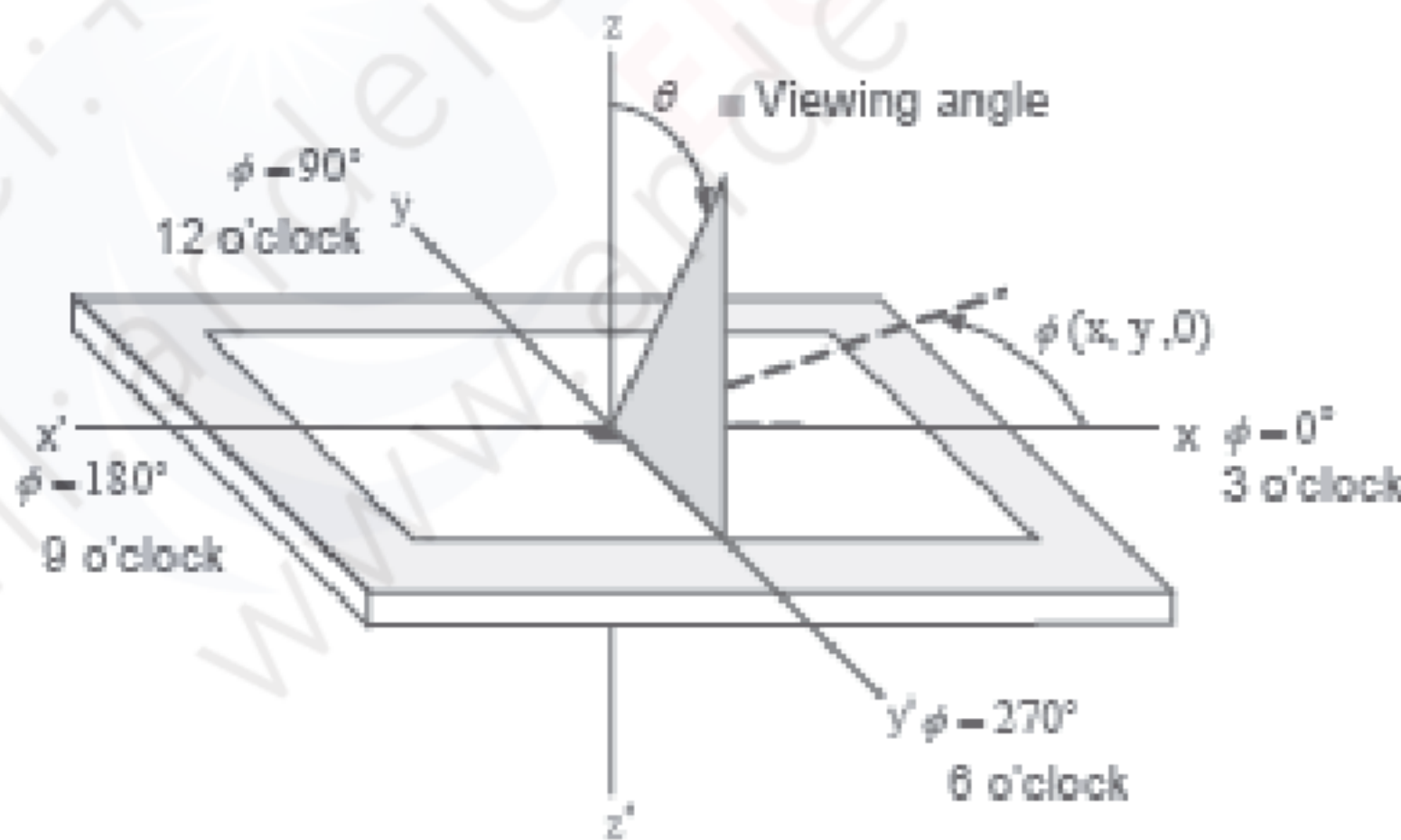
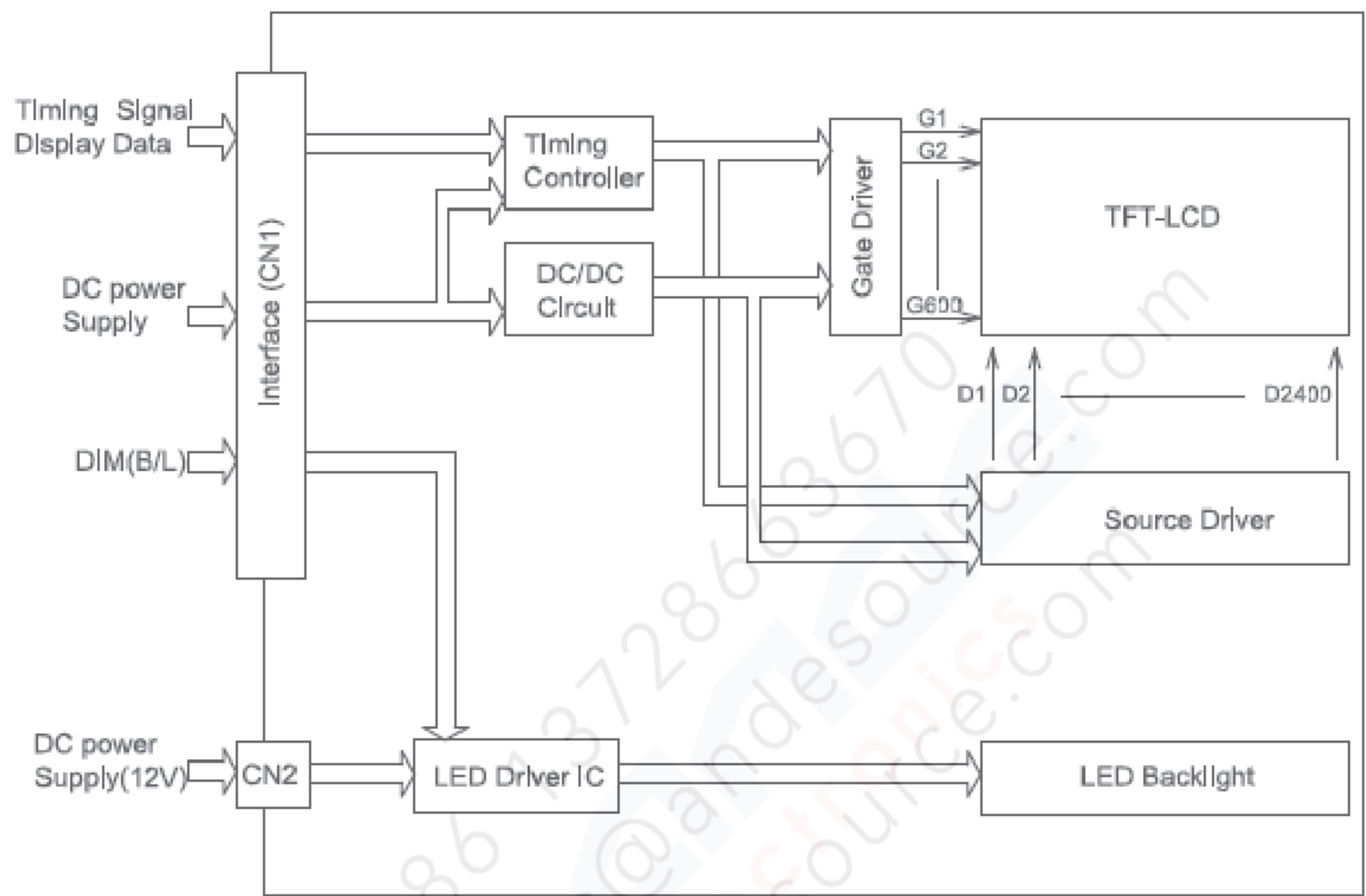


Fig. 6.4

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<br>4) Note 3                                                 | 240 hrs                                        |
| 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, 250 Ω<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 |

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°C, the humidity needs to be reduced as Fig. 8.1 shown.

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

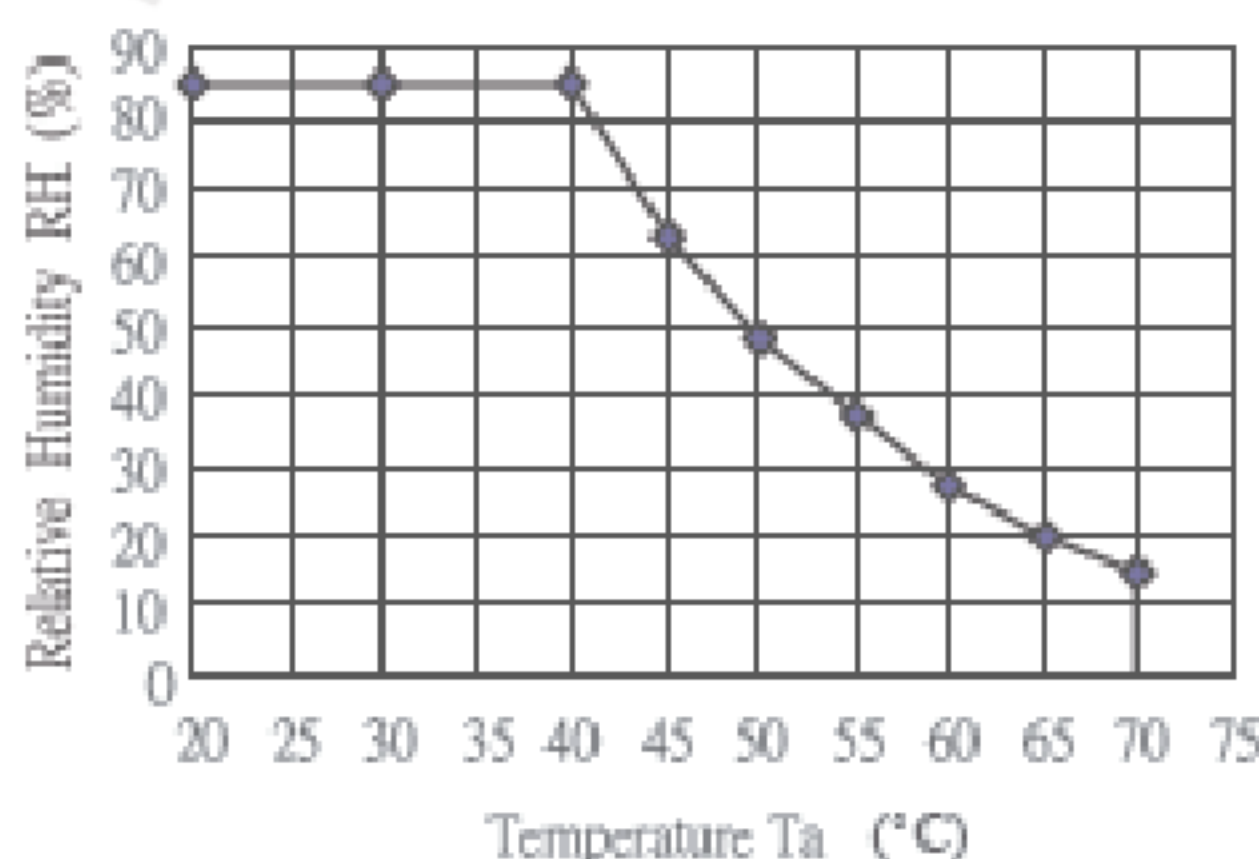


Fig. 8.1

## 9. LCD INTERFACE

### 9.1 INTERFACE PIN CONNECTIONS

The display interface connector 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. | Symbol  | Description                                                                                    | Note   |
|---------|---------|------------------------------------------------------------------------------------------------|--------|
| 1       | VDD     | Power Supply (typ.+3.3V)                                                                       | Note 3 |
| 2       | VDD     |                                                                                                |        |
| 3       | DIM     | Normal Brightness:0V or 0% PWM Duty<br>Brightness Control:0V to 3.3VDC or 0% to 100% PWM Duty. | -      |
| 4       | VSS     | GND (0V)                                                                                       | Note 1 |
| 5       | IN0-    | Pixel Data                                                                                     | Note 2 |
| 6       | IN0+    |                                                                                                |        |
| 7       | VSS     | GND (0V)                                                                                       | Note 1 |
| 8       | IN1-    | Pixel Data                                                                                     | Note 2 |
| 9       | IN1+    |                                                                                                |        |
| 10      | VSS     | GND (0V)                                                                                       | Note 1 |
| 11      | IN2-    | Pixel Data                                                                                     | Note 2 |
| 12      | IN2+    |                                                                                                |        |
| 13      | VSS     | GND (0V)                                                                                       | Note 1 |
| 14      | CLK IN- | Clock                                                                                          | Note 2 |
| 15      | CLK IN+ |                                                                                                |        |
| 16      | VSS     | GND (0V)                                                                                       | Note 1 |
| 17      | IN3-    | Pixel Data                                                                                     | Note 2 |
| 18      | IN3+    |                                                                                                |        |
| 19      | VSS     | GND (0V)                                                                                       | Note 1 |
| 20      | VSS     |                                                                                                |        |

Note 1: All VDD pins should be connected to +3.3V.

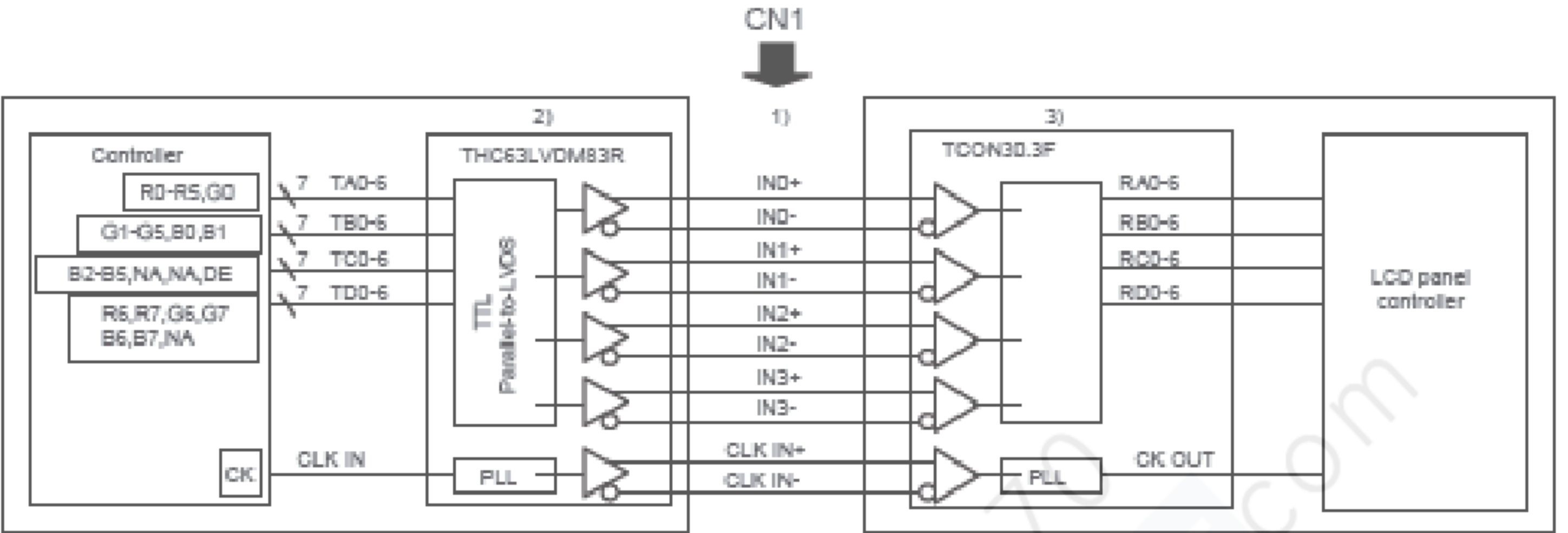
Note 2: All VSS pins should be connected to GND(0V),Metal bezel is connected internally to VSS.

Note 3: 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.

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

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

9.2 LVDS INTERFACE



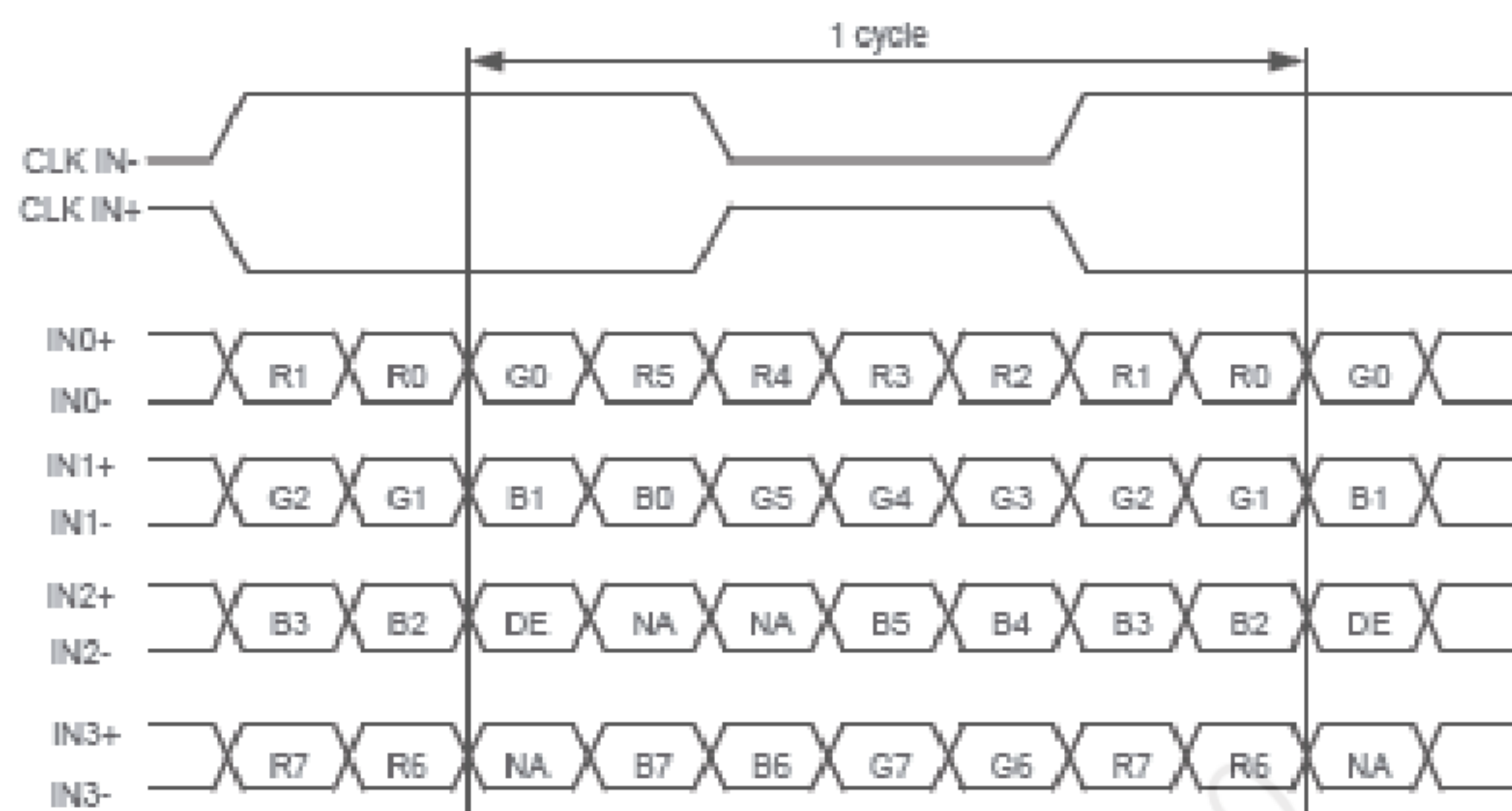
Note 1: 100Ω impedance of LVDS cable is recommended for best optical performance.

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

Note 3: Receiver (TCON30.3-F) • Made by Thine : THC63LVDF84B equivalent.

9.3 DATA MAPPING

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



DE : Display Enable

NA : Not Available

## 9.4 DATA INPUT for DISPLAY COLOR(8BIT MODE)

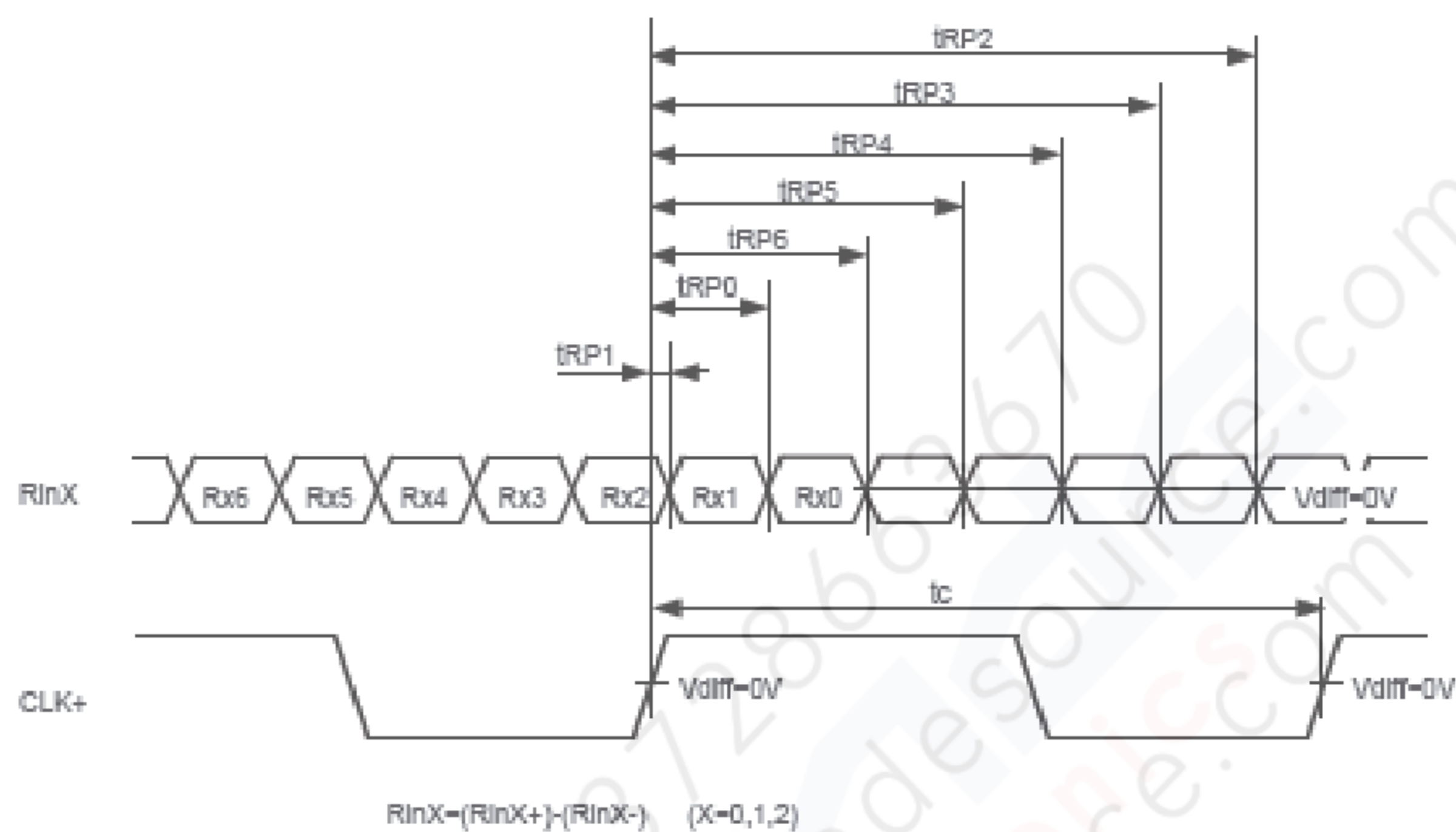
| Input<br>color |            | Red Data |    |    |    |    |    |    |    | Green Data |    |    |    |    |    |    |    | Blue Data |    |    |    |    |    |    |    |
|----------------|------------|----------|----|----|----|----|----|----|----|------------|----|----|----|----|----|----|----|-----------|----|----|----|----|----|----|----|
|                |            | 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 LSS  |    |    |    |    |    |    |    | MSB LSS    |    |    |    |    |    |    |    | MSB LSS   |    |    |    |    |    |    |    |
| Basic<br>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

9.5 INTERFACE TIMING

(1) LVDS Receiver Timing  
(Interface of TFT module)

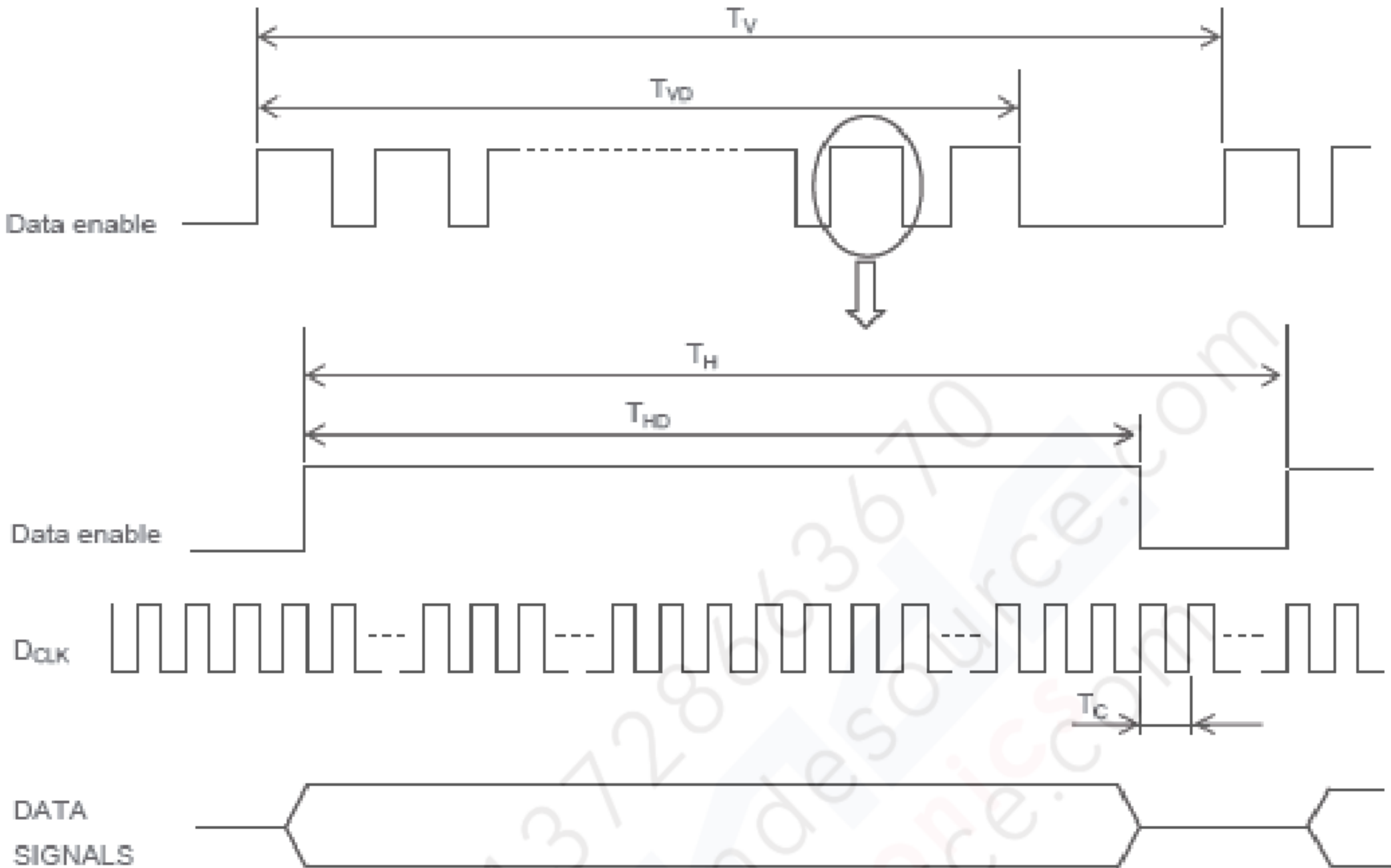


| Item                       |                   | Symbol    | Min.              | Typ.           |         | Max.              | Unit |
|----------------------------|-------------------|-----------|-------------------|----------------|---------|-------------------|------|
| DCLK                       | FREQUENCY         | $1/t_c$   | 25.0              | 28.0 1)        | 33.3 2) | 35.0              | MHz  |
| $R_{inX}$<br>( $X=0,1,2$ ) | 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:  $f_v=50\text{Hz}$   
Note 2:  $f_v=60\text{Hz}$

(2) Timing converter timing

(Input timing for transmitter)

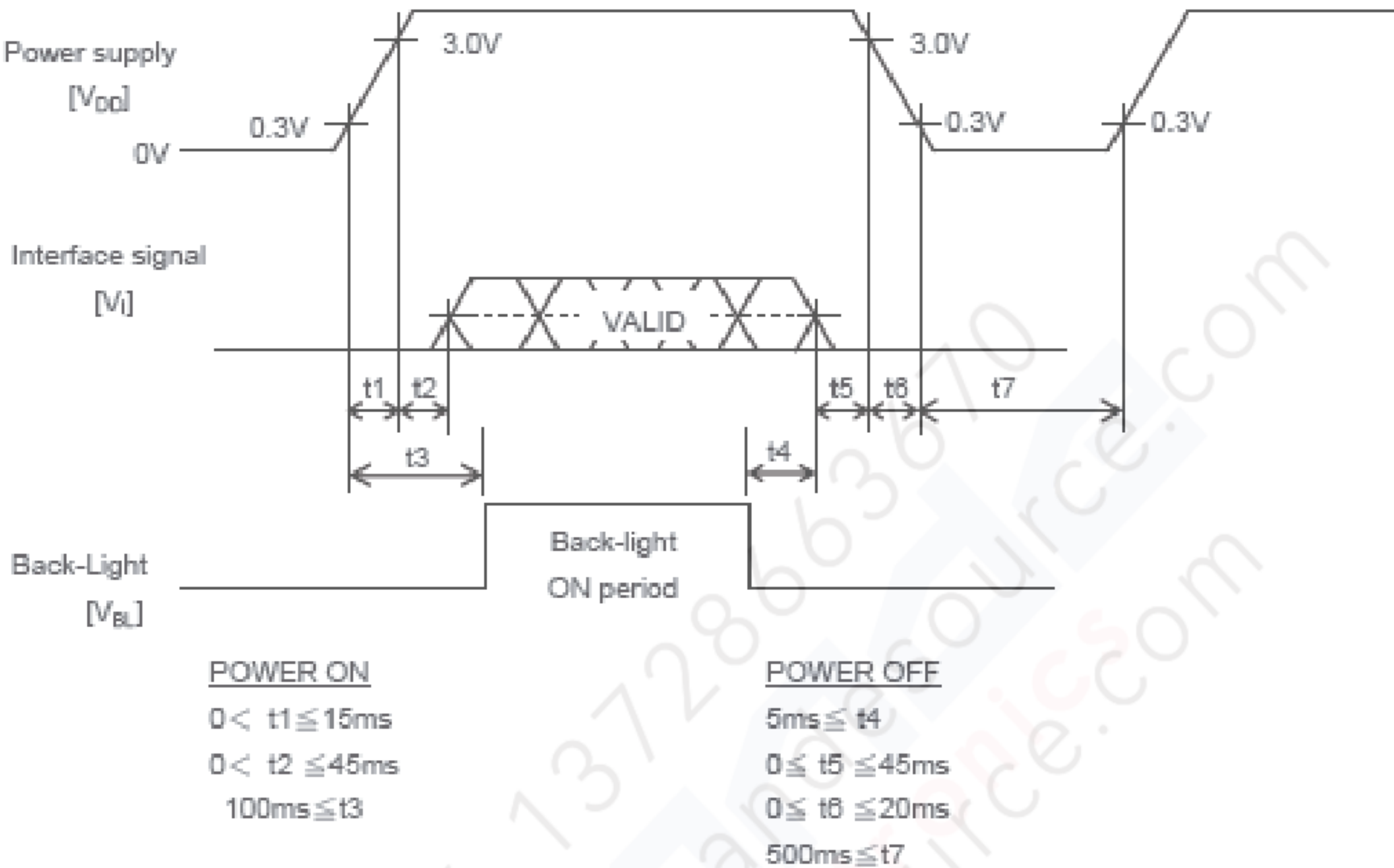


The timings except mentioned above are referred to the specifications of your transmitter.

| Item        |                         | Symbol   | Min. | Typ. | Max. | Unit  | Remarks |
|-------------|-------------------------|----------|------|------|------|-------|---------|
| DCLK        | Cycle time              | $T_C$    | 28.8 | 30.0 | 35.7 | ns    |         |
| Data Enable | Duty                    | D        | 0.45 | 0.5  | 0.5  | -     |         |
|             | Horizontal period       | $T_H$    | 842  | 1056 | 1056 | $T_C$ |         |
|             | Horizontal width-Active | $T_{HD}$ | 800  | 800  | 800  | $T_C$ |         |
|             | Vertical period         | $T_V$    | 482  | 525  | 525  | $T_H$ |         |
|             | Vertical width-Active   | $T_{VD}$ | 480  | 480  | 480  | $T_H$ |         |
|             | Frame frequency         | $f_V$    | 42   | 60   | 50   | Hz    |         |

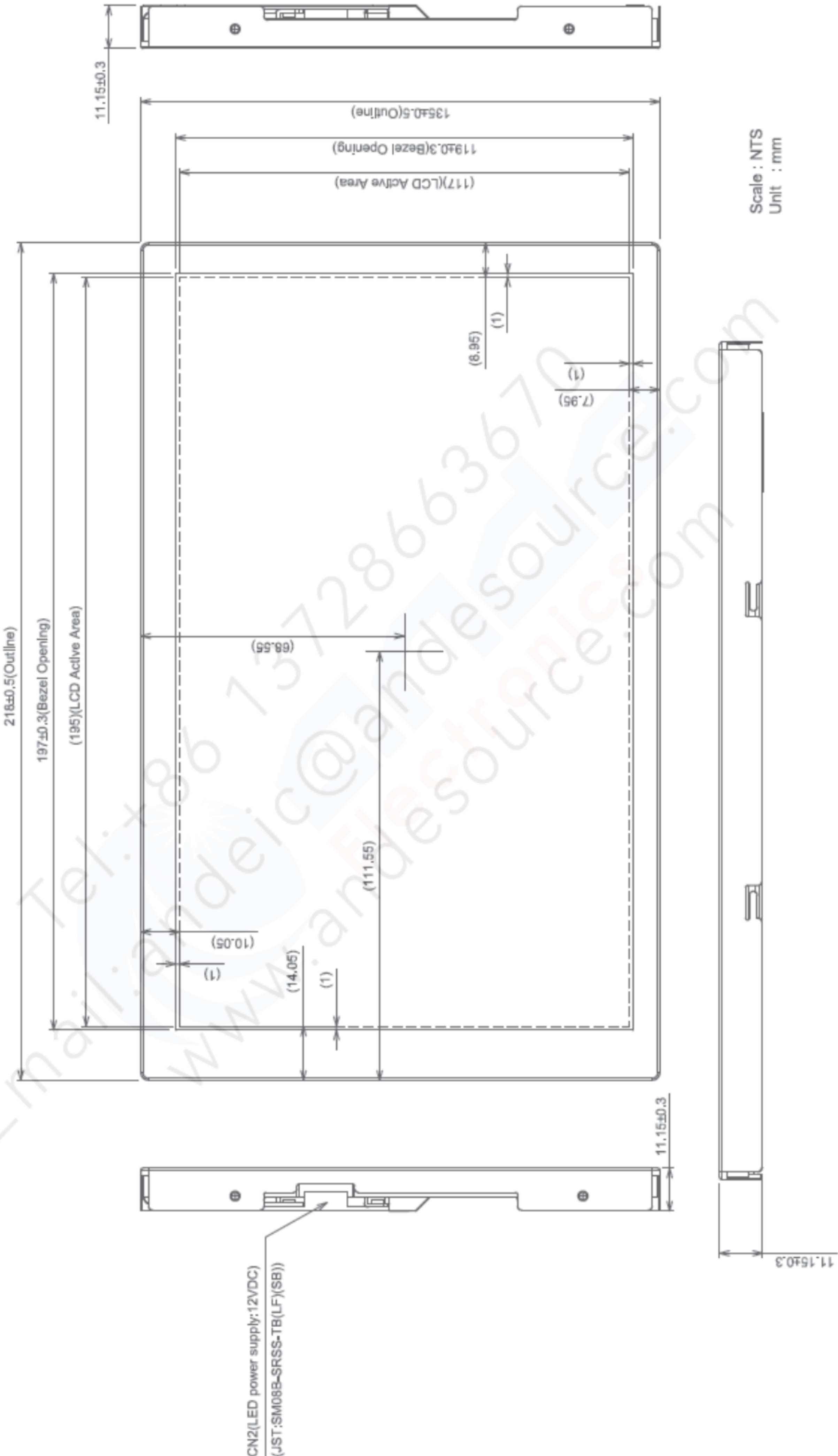
(3) TIMING BETWEEN INTERFACE SIGNAL AND POWER SUPPLY

Power Supply, Input Signal and Backlight Voltage ON/OFF/REENTRY should comply with the following sequence.

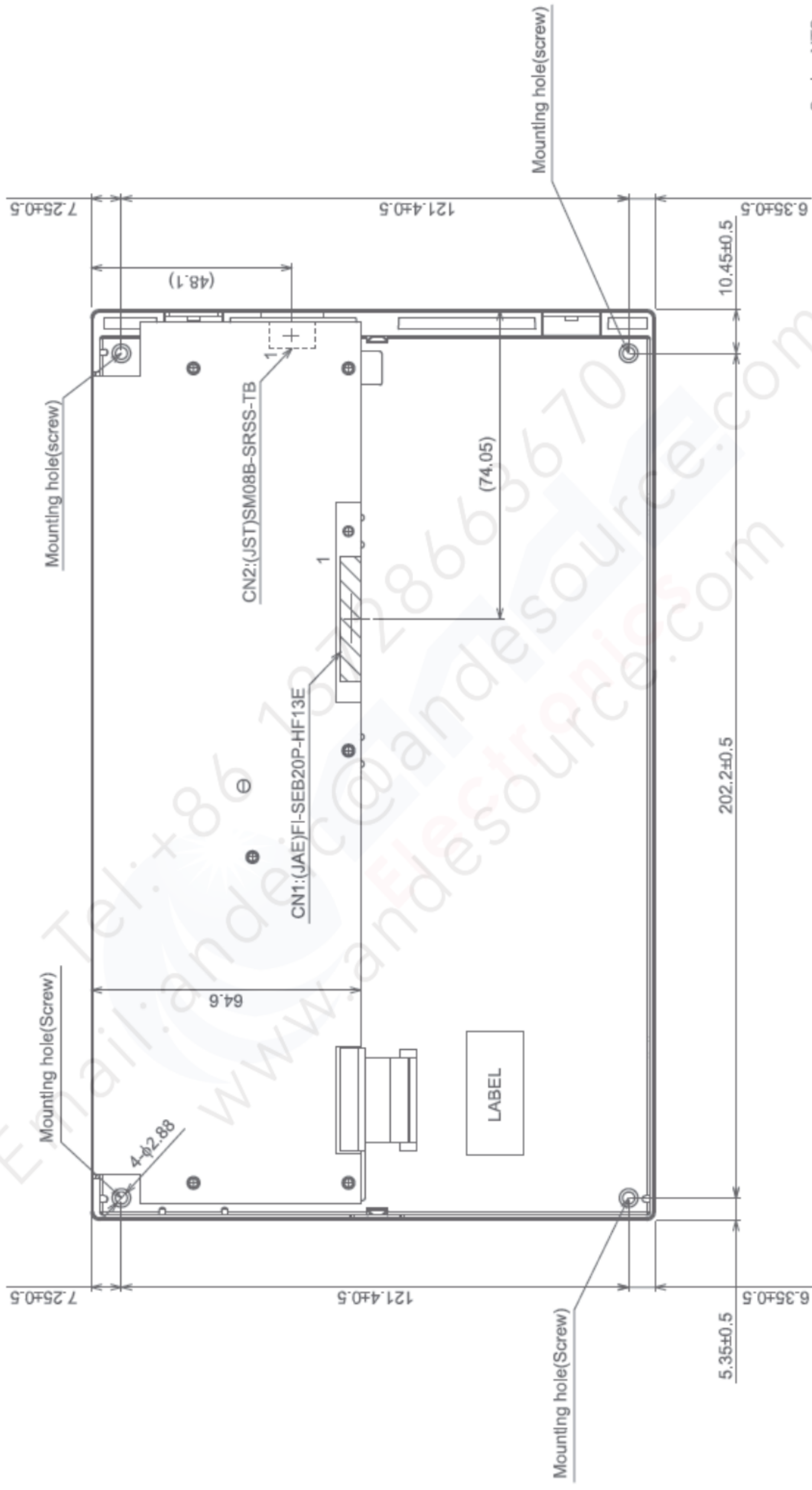


- Note 1: In order to prevent electronic parts from destruction caused by latch-up, please input signal after Power Supply Voltage ON. In addition, please turn off signals before power supply voltage OFF.
- Note 2: In order to prevent from function error due to residual charge, please reenter power supply 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 SURFACE SIDE



## 10.2 BACK SIDE



Scale : NTS  
Unit : mm

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

## 11. APPEARANCE STANDARD

The appearance inspection is performed in a dark room around 1200 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. 11.1 The inspection should be performed within  $45^\circ$  when display is shut down. The inspection should be performed within  $5^\circ$  when display is power on.

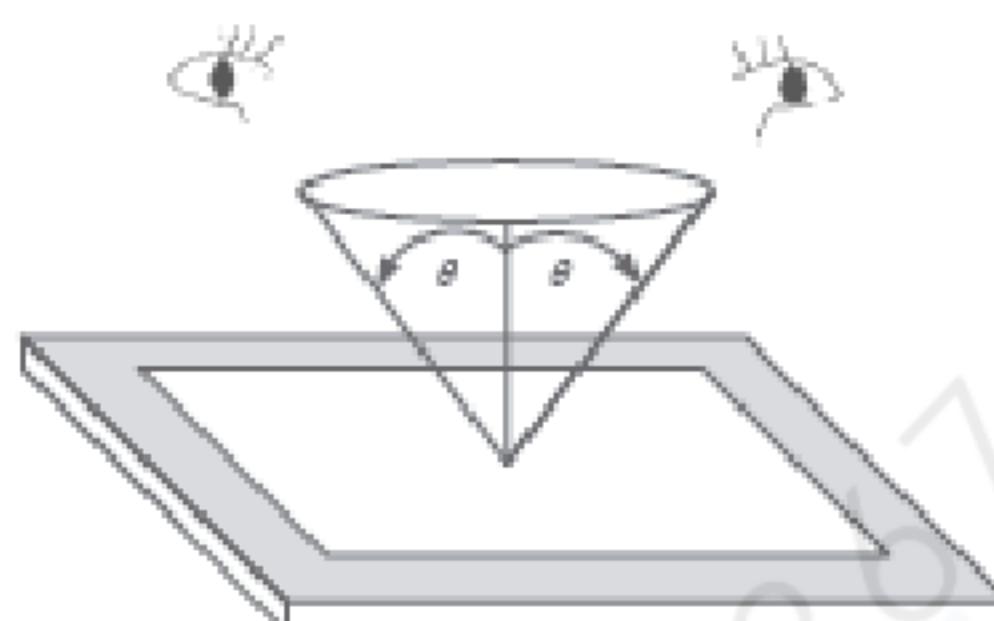


Fig. 11.1

### 11.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 3 areas as shown in Fig.11.2 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.

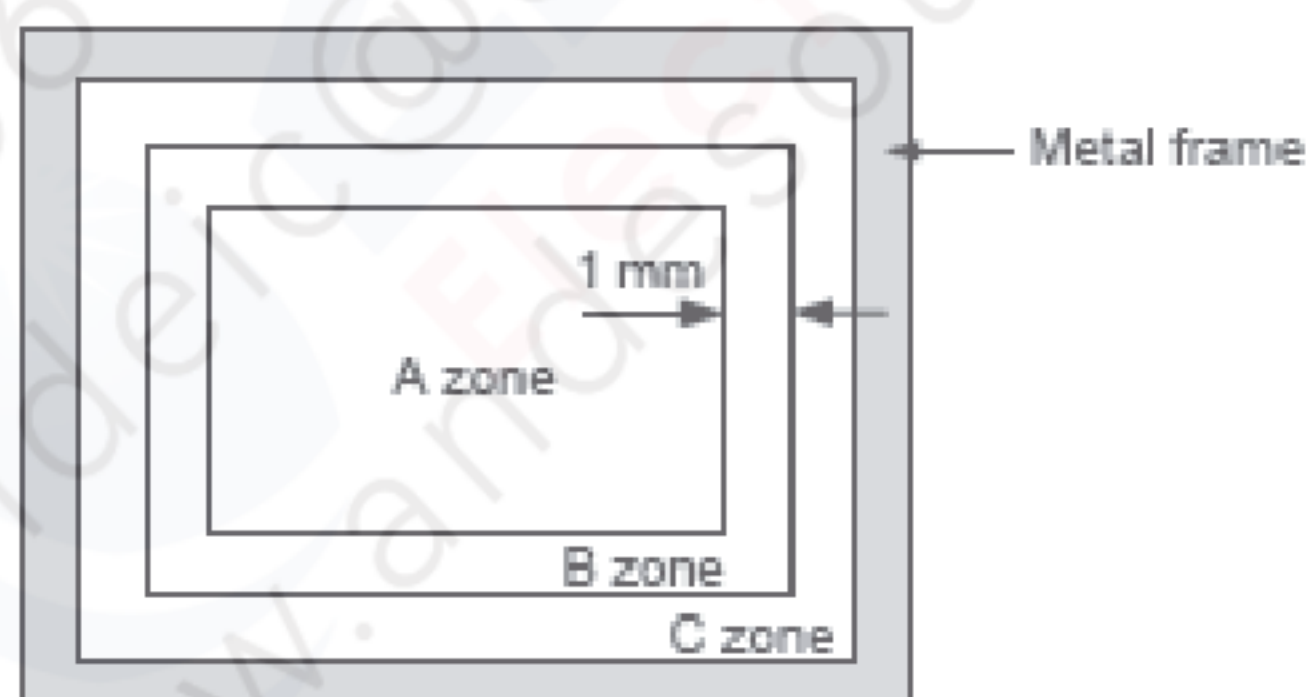


Fig. 11.2

## 11.2 LCD APPEARANCE SPECIFICATION

When displaying conditions are not stable (ex. at turn on or off), the following specifications are not applied.

Operating inspection

| No       | Item                                                                    |                 |            | Max. acceptable number     | Unit        | Remarks      |
|----------|-------------------------------------------------------------------------|-----------------|------------|----------------------------|-------------|--------------|
|          |                                                                         |                 |            | A-ZONE                     |             |              |
| 1        | Dot defect                                                              | Sparkle mode    | 1-dot      | 2                          | pcs         | Note 1,2,4   |
|          |                                                                         |                 | 2-dots     | 1                          | Units       | Note 1,2,5   |
|          |                                                                         |                 | 3-dots     | 0                          |             |              |
|          |                                                                         |                 | Total      | 2                          | Units       | Note 1,2     |
|          |                                                                         | Black mode      | 1-dot      | 3                          | pcs         | Note 1,3,4   |
|          |                                                                         |                 | 2-dots     | 2                          | Units       | Note 1,3,5   |
|          |                                                                         |                 | 3-dots     | 0                          |             |              |
|          |                                                                         |                 | Total      | 3                          | Units       | Note 1,3     |
|          |                                                                         | Total           | Density    | 1                          | Units/φ80mm | Note 1,2,3,6 |
|          |                                                                         |                 | Total      | 3                          | Units       | Note 1       |
| 2        | Line defect                                                             |                 |            | Serious one is not allowed | -           | -            |
| 3        | Uneven brightness                                                       |                 |            |                            |             |              |
| 4        | Stain inclusion<br>Line shape<br>W : width (mm)<br>L : length (mm)      | W ≤ 0.02        | L : Ignore | Ignore                     | pcs         | Note 7       |
|          |                                                                         | W ≤ 0.03        | L ≤ 2.0    | 10                         |             |              |
|          |                                                                         |                 | L > 2.0    | 0                          |             |              |
|          |                                                                         | W ≤ 0.06        | L ≤ 1.0    | 10                         |             |              |
|          |                                                                         |                 | L > 1.0    | 0                          |             |              |
| W > 0.06 | -                                                                       | (See dot shape) |            |                            |             |              |
| 5        | Stain inclusion<br>Dot shape<br>D : ave. dia (mm)                       | D ≤ 0.22        |            | Ignore                     | pcs         | Note 7       |
|          |                                                                         | D ≤ 0.33        |            | 5                          |             |              |
|          |                                                                         | D > 0.33        |            | 0                          |             |              |
| 6        | Scratch on polarizer<br>Line shape<br>W : width (mm)<br>L : length (mm) | W ≤ 0.01        | L : Ignore | Ignore                     | pcs         | Note 8       |
|          |                                                                         | W ≤ 0.02        | L ≤ 40     | 10                         |             |              |
|          |                                                                         |                 | L > 40     | 0                          |             |              |
|          |                                                                         | W ≤ 0.04        | L ≤ 20     | 10                         |             |              |
| L > 20   | 0                                                                       |                 |            |                            |             |              |
| 7        | Scratch on polarizer<br>Dot shape<br>D : ave. dia (mm)                  | D ≤ 0.2         |            | Ignore                     | pcs         | Note 8       |
|          |                                                                         | D ≤ 0.4         |            | 10                         |             |              |
|          |                                                                         | D > 0.4         |            | 0                          |             |              |

Non-operating inspection

| No | ITEM                                                  |              | Max. acceptable number        | Unit | Remarks |
|----|-------------------------------------------------------|--------------|-------------------------------|------|---------|
|    |                                                       |              | A-zone                        |      |         |
| 8  | Bubbles, peeling<br>In polarizer<br>( D:ave.dia(mm) ) | $D \leq 0.3$ | Ignore                        | pcs  | Note 8  |
|    |                                                       | $D \leq 0.5$ | 10                            |      |         |
|    |                                                       | $D \leq 1.0$ | 5                             |      |         |
|    |                                                       | $D > 1.0$    | 0                             |      |         |
| 9  | Wrinkles on polarizer                                 |              | Serious one is<br>not allowed | -    | -       |

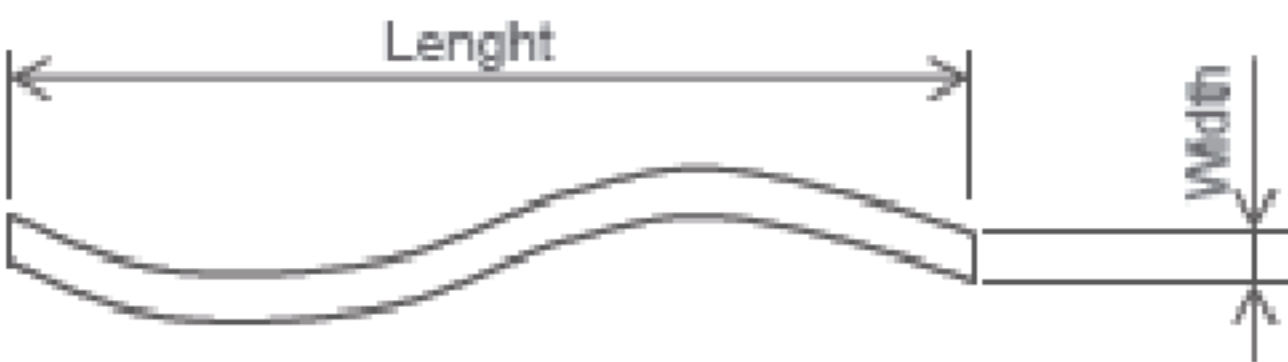


Fig 11.3



Fig 11.4

- Note 1: Dot defect : defect area > 1/2 dot
- Note 2: Sparkle mode : brightness of dot is more than 30% at black raster.
- Note 3: Black mode : brightness of dot is less than 70% at white raster.
- Note 4: 1 dot : defect dot is isolated, not attached to other defect dot.
- Note 5: N dots : N defect dots are consecutive. (N means the number of defects dots)
- Note 6: Density : number of defect dots inside 20mm  $\phi$ .
- Note 7: Those stains which can be wiped out easily are acceptable.
- Note 8: Polarizer area inside of B-zone is not applied.

## 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.
- 1) 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.
- 2) 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.
- 3) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean display's surfaces.
- 4) 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.
- 5) Please wipe any unknown liquids immediately such as saliva, water or dew on the display to avoid color fading or any permanently damages.
- 6) 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  $25^\circ\text{C}$ . 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

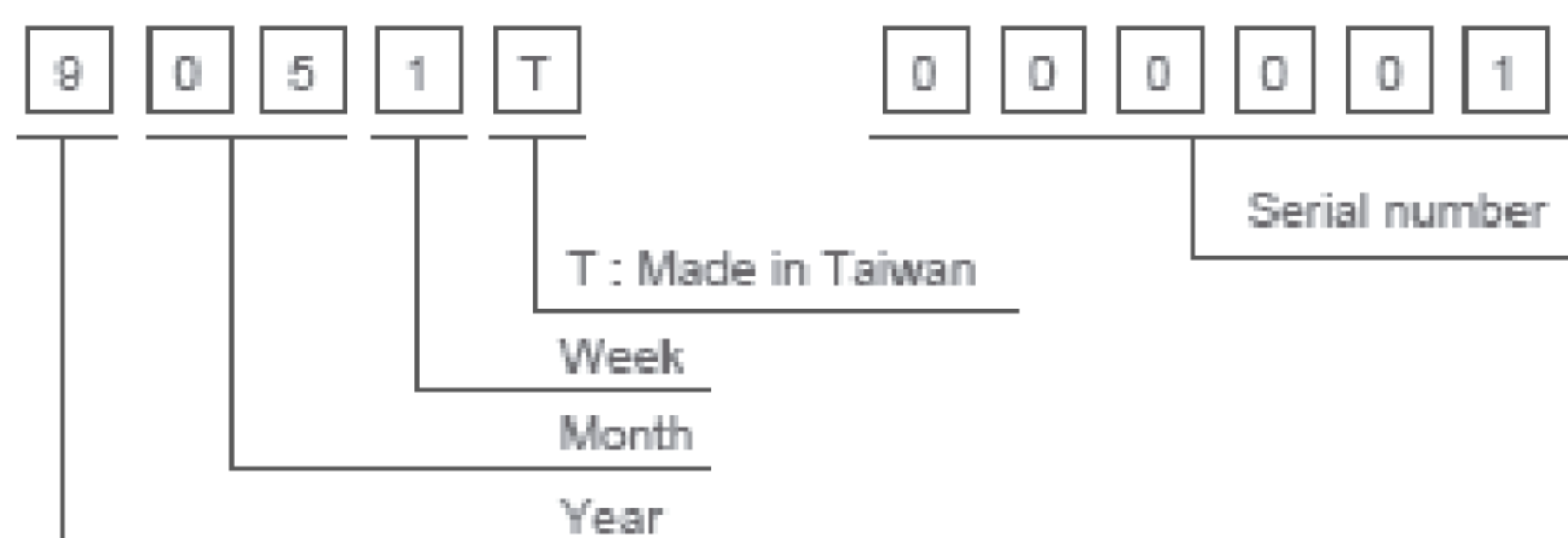
If the displays are going to be stored for years, please be aware the following notices.

- 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 Hitachi, and do not unpack it.
- 4) Please do not stick any labels on the display surface for a long time, especially on the polarizer.

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## 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.



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

| Year | Mark |
|------|------|
| 2009 | 9    |
| 2010 | 0    |
| 2011 | 1    |
| 2012 | 2    |
| 2013 | 3    |

| 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.  
 4) The location of the lot mark is on the back of the display shown in Fig. 13.1.

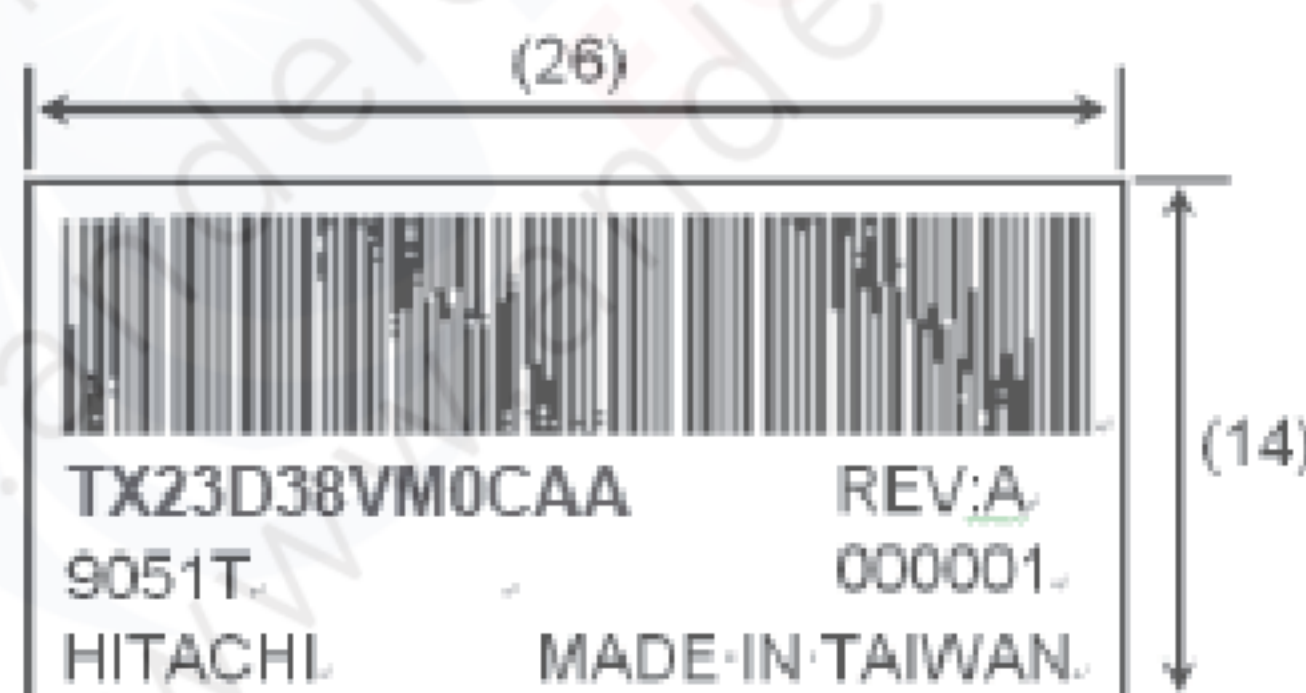


Fig 13.1