

Kaohsiung Opto-Electronics Inc.

FOR MESSRS : _____

DATE : Nov. 1st, 2013

TECHNICAL DATA

TX13D200VM5BAA

Contents

| No. | ITEM | SHEET No. | PAGE |
|-----|----------------------------|----------------|-----------|
| 1 | COVER | 7B64LTD-2421-1 | 1-1/1 |
| 2 | RECORD OF REVISION | 7B64LTD-2421-1 | 2-1/1 |
| 3 | GENERAL DATA | 7B64LTD-2421-1 | 3-1/1 |
| 4 | ABSOLUTE MAXIMUM RATINGS | 7B64LTD-2421-1 | 4-1/1 |
| 5 | ELECTRICAL CHARACTERISTICS | 7B64LTD-2421-1 | 5-1/1 |
| 6 | OPTICAL CHARACTERISTICS | 7B64LTD-2421-1 | 6-1/2~2/2 |
| 7 | BLOCK DIAGRAM | 7B64LTD-2421-1 | 7-1/1 |
| 8 | LCD INTERFACE | 7B64LTD-2421-1 | 8-1/7~7/7 |
| 9 | OUTLINE DIMENSIONS | 7B64LTD-2421-1 | 9-1/2~2/2 |

ACCEPTED BY: _____

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2. RECORD OF REVISION

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

3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 5" VGA of 4:3 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 | TX13D200VM5BAA |
| Module Dimensions | 119.4(W)mm x 89.1(H)mm x 9.3(D)mm typ |
| LCD Active Area | 101.76(W)mm x 76.32(H)mm |
| Pixel Pitch | 0.053(W)mm x 3(R,G,B)(W) x 0.159(H)mm |
| Resolution | 640x3(R,G,B)(W)x480(H) dots |
| Color Pixel Arrangement | R, G, B Vertical stripe |
| LCD Type | Transmissive Color TFT; Normally White |
| Display Type | Active Matrix |
| Top Polarizer Type | Anti-glare Polarizer Film |
| Number of Colors | 262k Colors (R,G,B 6bit digital each) |
| Backlight | Light Emitting Diode (LED) |
| Weight | 110 g (typ.) |
| Interface | 40pin C-MOS |
| Power Supply Voltage | 3.3V for LCD driving 12 V for B / L driving |
| Power Consumption | 0.5 W for LCD ; 3 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 | 5.0 | V | - |
| Input Voltage of Logic | V_I | -0.3 | $V_{DD}+0.3$ | V | Note 1 |
| Operating Temperature | T_{op} | -30 | 80 | °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 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

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

| 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 | $0.7V_{DD}$ | - | $V_{DD}+0.3$ | V | Note 1 |
| | | "L" level | -0.3 | - | $0.25V_{DD}$ | | |
| Power Supply Current | I_{DD} | $V_{DD}=3.3\text{V}$ | - | 135 | 160 | mA | Note 2,3 |
| Vsync Frequency | f_v | - | 50 | 60 | 70 | Hz | - |
| Hsync Frequency | f_H | - | 26.25 | 31.50 | 36.75 | KHz | - |
| DCLK Frequency | f_{CLK} | - | 21.0 | 25.2 | 29.4 | MHz | - |

Note1: The rating is defined for the signal voltages of the interface such as DE, DCLK and RGB data bus.

Note 2: An all black check pattern is used when measuring I_{DD} . f_v 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

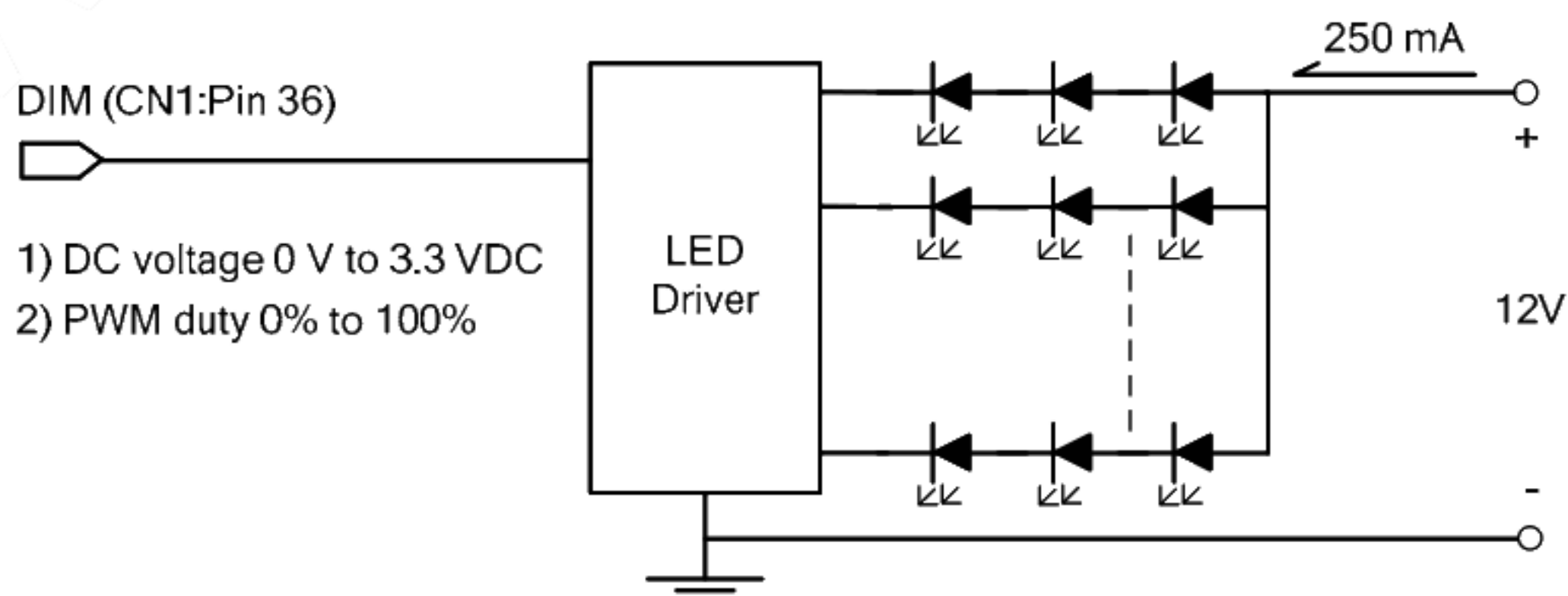
$T_a = 25\text{ }^\circ\text{C}$

| 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 | 220 | 250 | 280 | mA | Note 2 |
| | | 3.3VDC; 100% duty | - | 30 | 36 | | |
| LED lifetime | - | 250 mA | - | 70K | - | hrs | Note 3 |

Note 1: As Fig. 5.1 shown, LED current is constant, 250 mA, controlled by the LED driver when applying 12V V_{LED} .

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

Note 3: The estimated lifetime is specified as the time to reduce 50% brightness by applying 250 mA at $25\text{ }^\circ\text{C}$.



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.

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

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remarks |
|-------------------------------------|---------------|--|------|------|------|-------------------|---------|
| Brightness of White | - | $\phi = 0^\circ, \theta = 0^\circ,$ $I_{LED} = 250\text{ mA}$ | 500 | 600 | - | cd/m ² | Note 1 |
| Brightness Uniformity | - | | 70 | - | - | % | Note 2 |
| Contrast Ratio | CR | | 200 | 370 | - | - | Note 3 |
| Response Time (Rising + Falling) | $T_r + T_f$ | $\phi = 0^\circ, \theta = 0^\circ$ | - | - | 45 | ms | Note 4 |
| 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 | 0.58 | 0.63 | 0.68 | - | Note 6 |
| | | Y | 0.27 | 0.32 | 0.37 | | |
| | Green | X | 0.29 | 0.34 | 0.39 | | |
| | | Y | 0.51 | 0.56 | 0.61 | | |
| | Blue | X | 0.10 | 0.15 | 0.20 | | |
| | | Y | 0.05 | 0.10 | 0.15 | | |
| | 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.

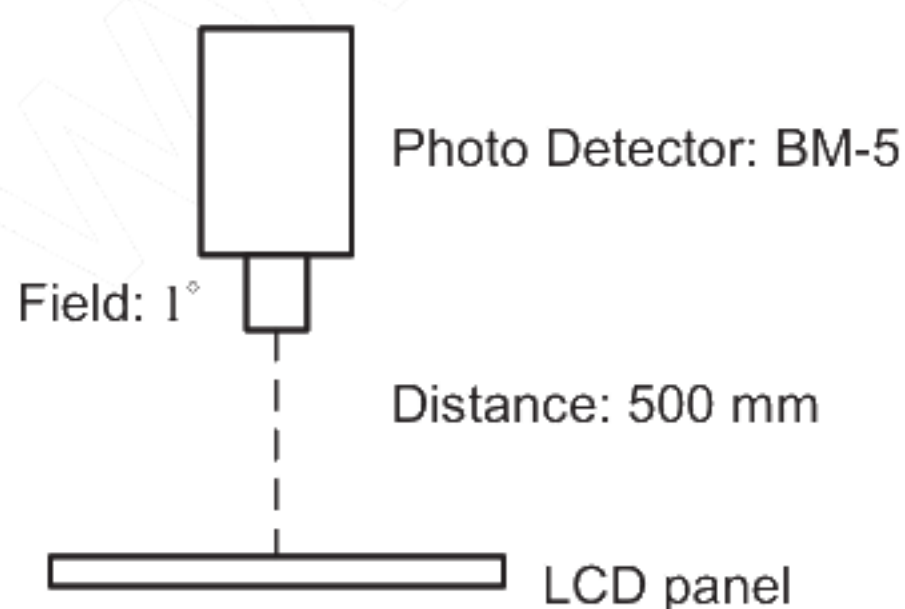


Fig 6.1

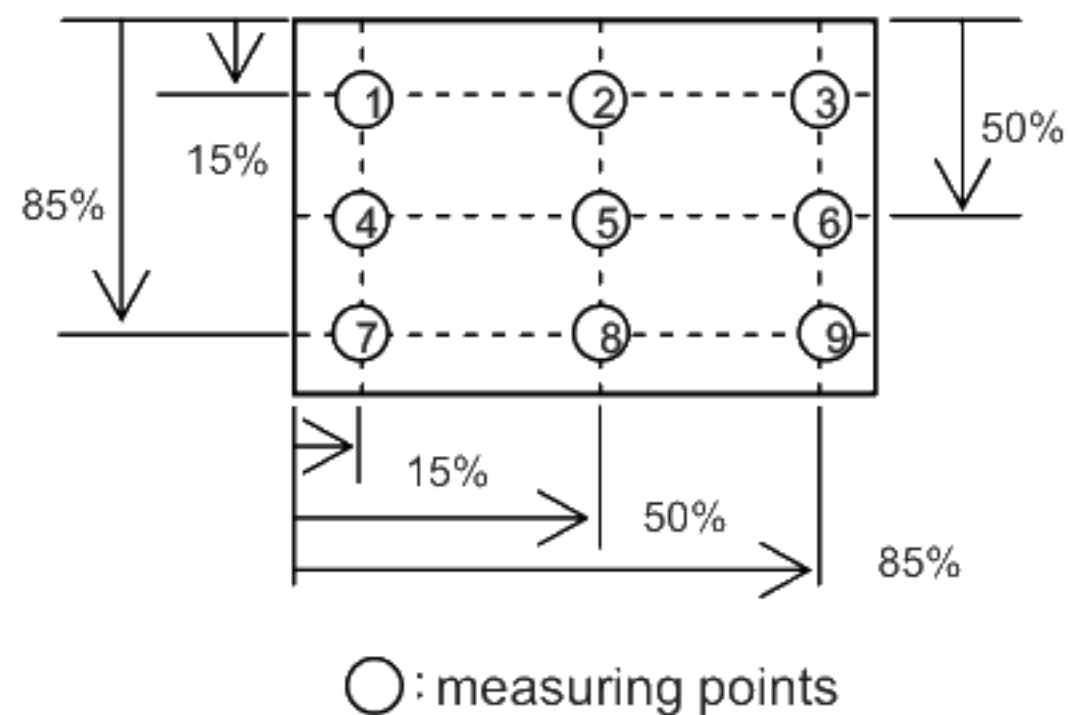


Fig 6.2

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

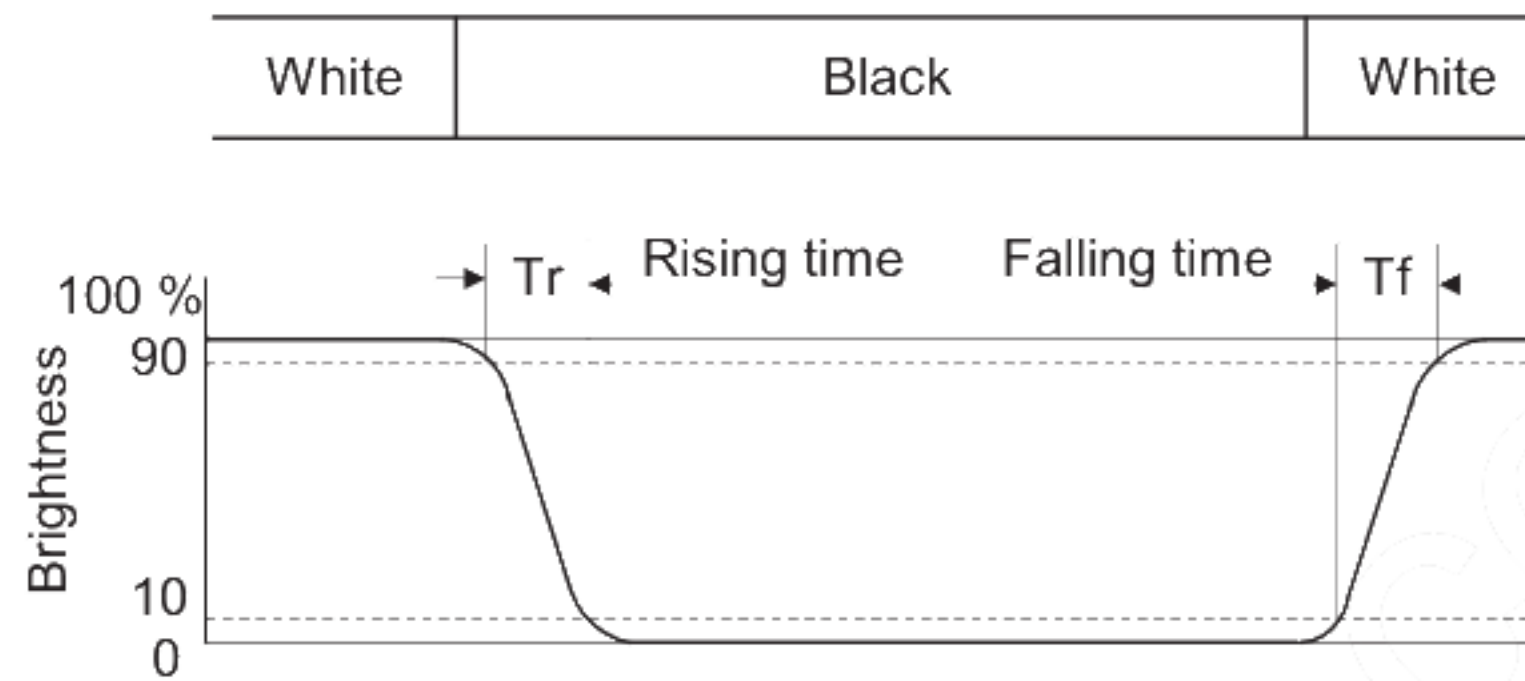


Fig . 6.3

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.

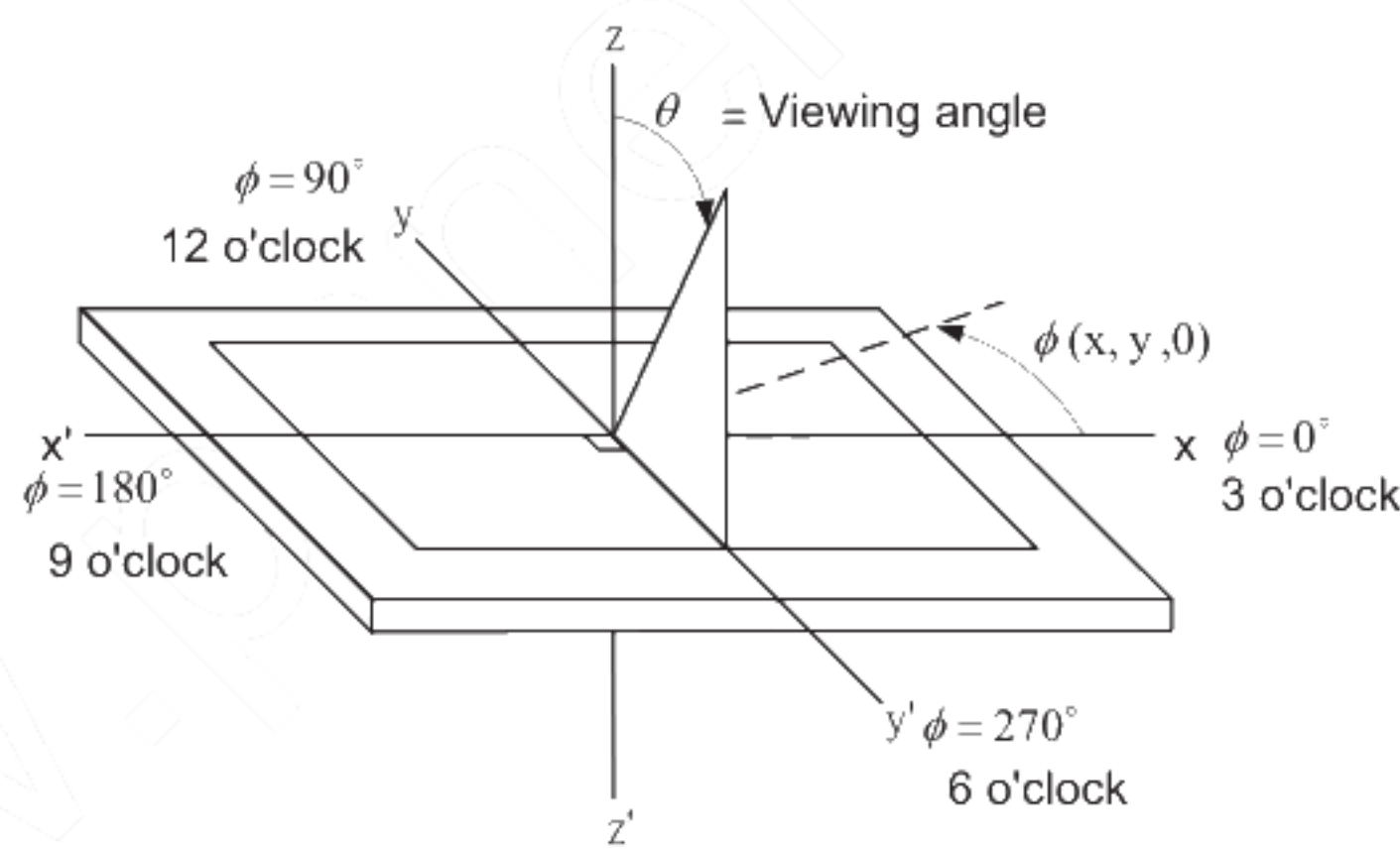
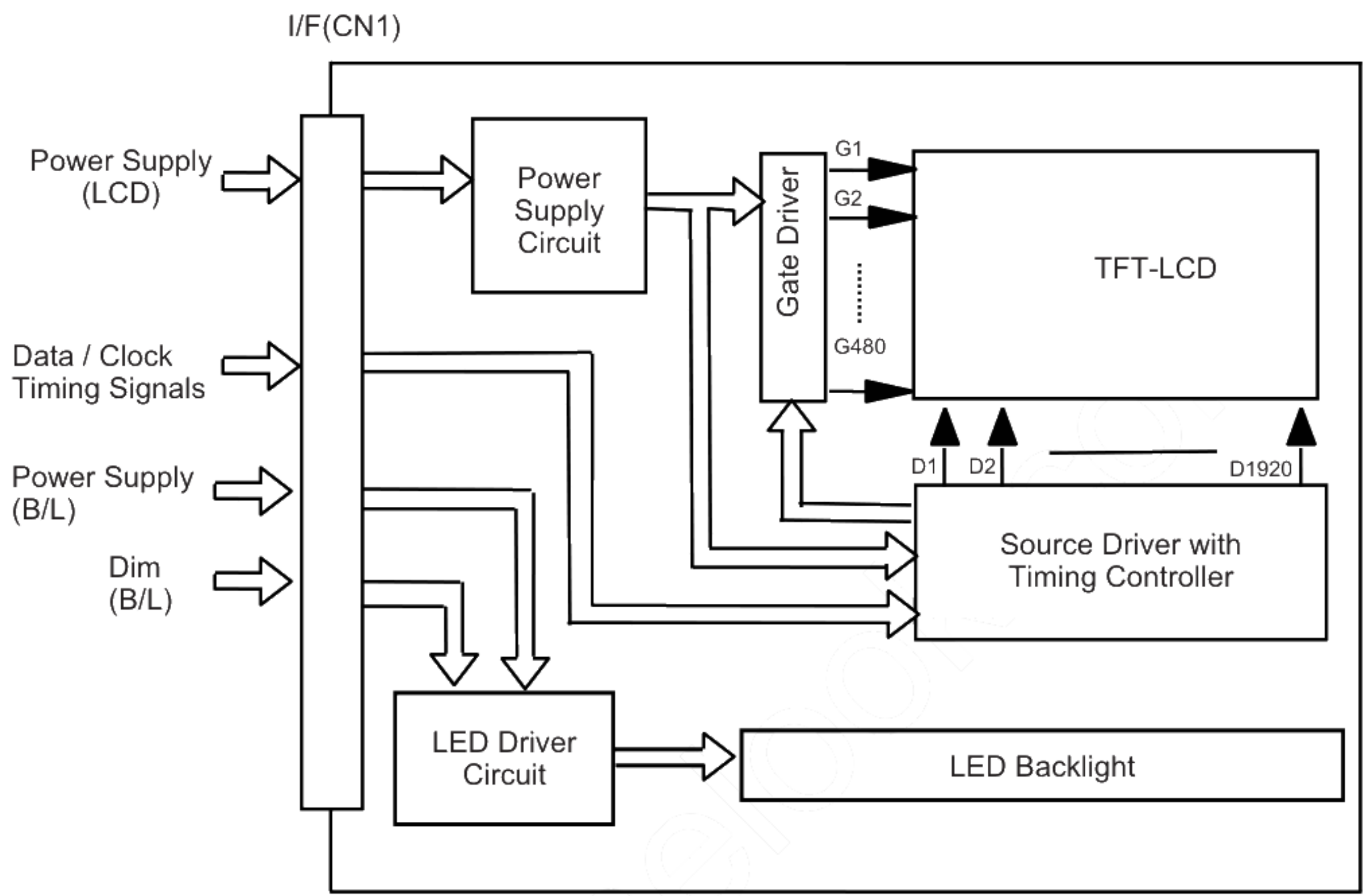


Fig 6.4

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 FA5S040HP1R3000 (JAE), and Pin assignment is as below:

| Pin No. | Symbol | Signal | Pin No. | Symbol | Signal |
|---------|-----------------|---------------------------------|---------|------------------|----------------------|
| 1 | V _{DD} | Supply Voltage | 21 | G4 | Green data |
| 2 | | | 22 | G3 | Green data |
| 3 | L/R | Horizontal Display mode Control | 23 | V _{SS} | Ground |
| 4 | U/D | Vertical Display mode Control | 24 | G2 | Green data |
| 5 | NC | No Connection | 25 | G1 | Green data |
| 6 | DE | Data Enable | 26 | G0 | Green data (LSB) |
| 7 | V _{SS} | Ground | 27 | V _{SS} | Ground |
| 8 | DCLK | Dot clock | 28 | R5 | Red data (MSB) |
| 9 | V _{SS} | Ground | 29 | R4 | Red data |
| 10 | NC | No Connection | 30 | R3 | Red data |
| 11 | V _{SS} | Ground | 31 | V _{SS} | Ground |
| 12 | B5 | Blue data (MSB) | 32 | R2 | Red data |
| 13 | B4 | Blue data | 33 | R1 | Red data |
| 14 | B3 | Blue data | 34 | R0 | Red data (LSB) |
| 15 | V _{SS} | Ground | 35 | NC | No Connection |
| 16 | B2 | Blue data | 36 | DIM | Note 1 |
| 17 | B1 | Blue data | 37 | V _{LED} | Power Supply for B/L |
| 18 | B0 | Blue data (LSB) | 38 | | |
| 19 | V _{SS} | Ground | 39 | | |
| 20 | G5 | Green data (MSB) | 40 | | |

Note 1: Normal brightness: 0V or 0% PWM duty; Brightness control: 0V to 3.3V DC or 0% to 100% PWM duty.

8.2 TIMING CHART

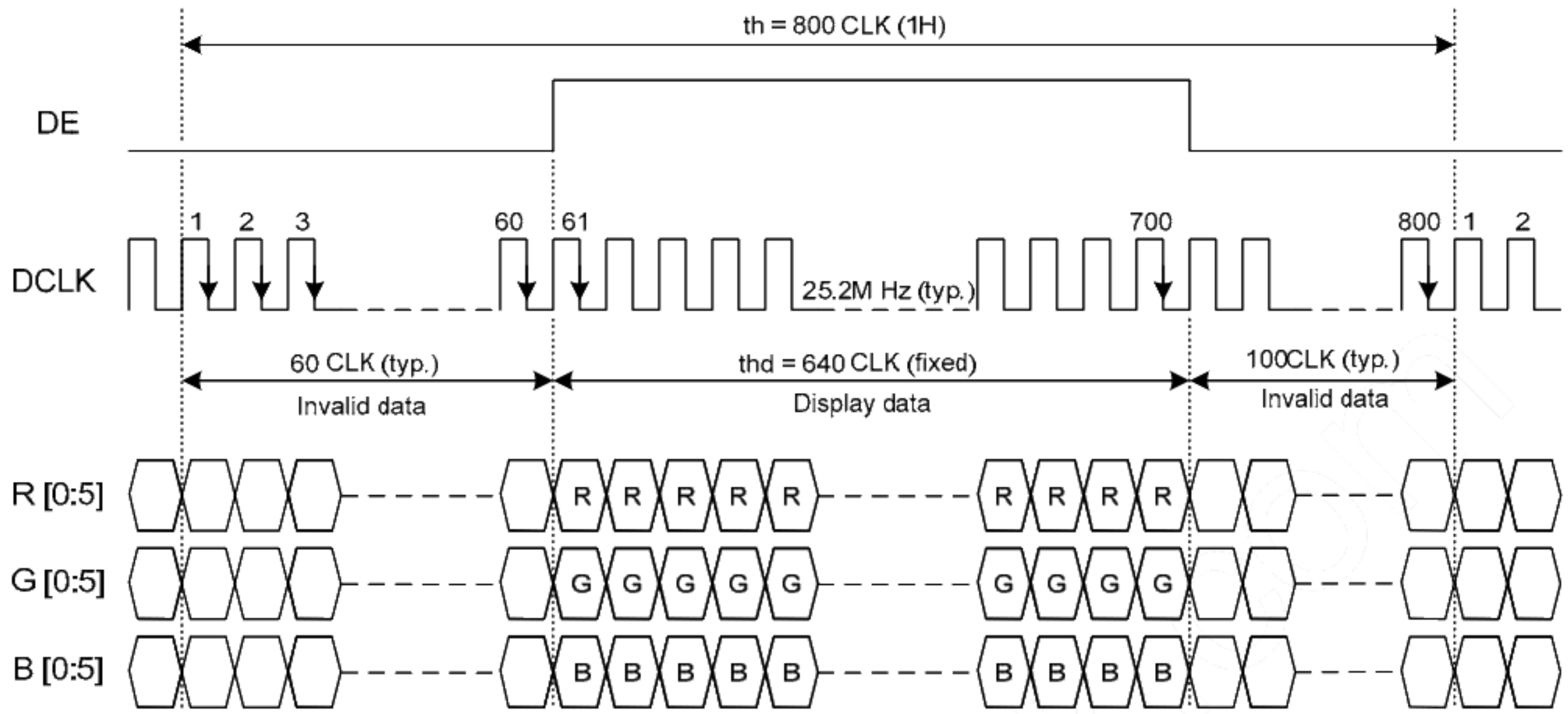


Fig. 8.1 Horizontal Timing

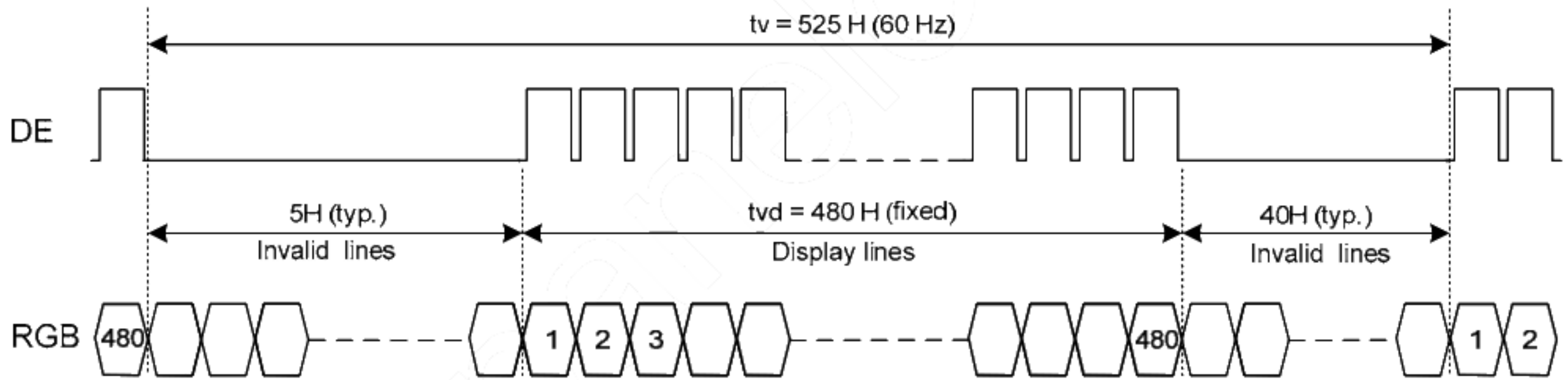


Fig. 8.2 Vertical Timing

8.3 CLOCK AND DATA INPUT TIMING

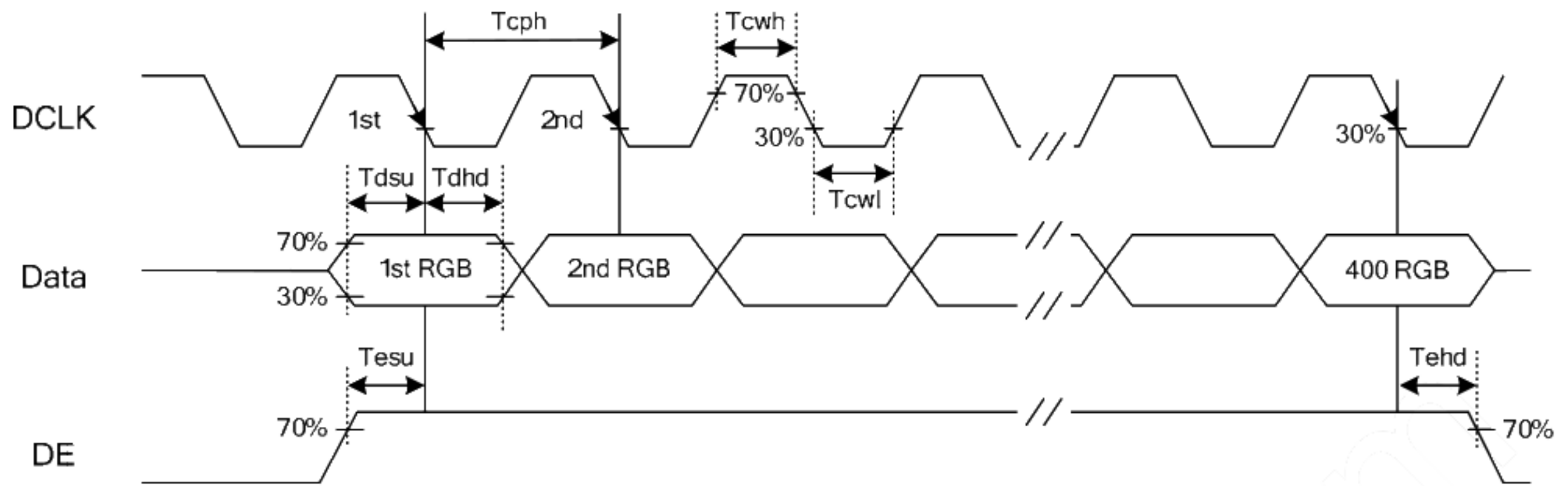


Fig. 8.3 Setup & Hold Time of Data and DE signal.

8.4 TIME TABLE

The column of timing sets including minimum, typical, and maximum as below are based on the best optical performance, frame frequency (Vsync) = 60 Hz to define. If 60 Hz is not the aim to set, 50~70 Hz for Vsync is recommended to apply for better performance by other parameter combination as the definitions in section 5.1.

FOR TIMING CHART

| | Item | Symbol | Min. | Typ. | Max. | Unit |
|------------|---------------|--------|------|------|------|------|
| Horizontal | CLK Frequency | fclk | 21.0 | 25.2 | 29.7 | M Hz |
| | Display Data | thd | 640 | 640 | 640 | CLK |
| | Cycle Time | th | 700 | 800 | 900 | |
| Vertical | Display Data | tvd | 480 | 480 | 480 | H |
| | Cycle Time | tv | 500 | 525 | 550 | |

FOR CLOCK AND DATA INPUT TIMING

| | Item | Symbol | Min. | Typ. | Max. | Unit |
|------|------------|--------|------|------|------|------|
| DCLK | Duty | Tcwh | 45 | 50 | 55 | % |
| | Cycle Time | Tcph | 34 | 40 | - | ns |
| Data | Setup Time | Tdsu | 12 | - | - | |
| | Hold Time | Tdhd | 12 | - | - | |
| DE | Setup Time | Tesu | 12 | - | - | |
| | Hold Time | Tehd | 12 | - | - | |

8.5 POWER SEQUENCE

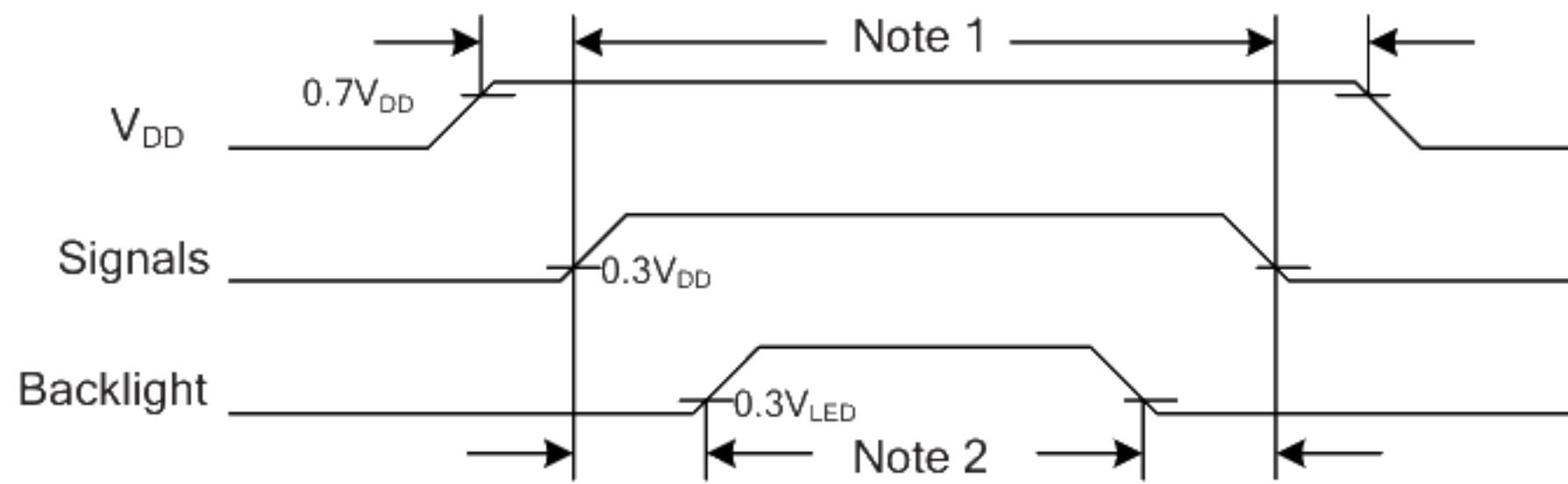


Fig. 8.4 Power Sequence Timing

Note 1: In order to avoid any damages, V_{DD} has to be applied before all other signals. The opposite is true for power Off where V_{DD} has to be remained on until all other signals have been switch off. The recommended time period is 1 second. Hot plugging might cause display damage due to incorrect power sequence, please pay attention on interface connecting before power on.

Note 2: In order to avoid showing uncompleted patterns in transient state. It is recommended that switching the backlight on is delayed for 1 second after the signals have been applied. The opposite is true for power Off where the backlight has to be switched off 1 second before the signals are removed.

8.6 SCAN DIRECTION

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



L/R : L , U/D : L
(default)



L/R : H , U/D : L



L/R : L , U/D : H



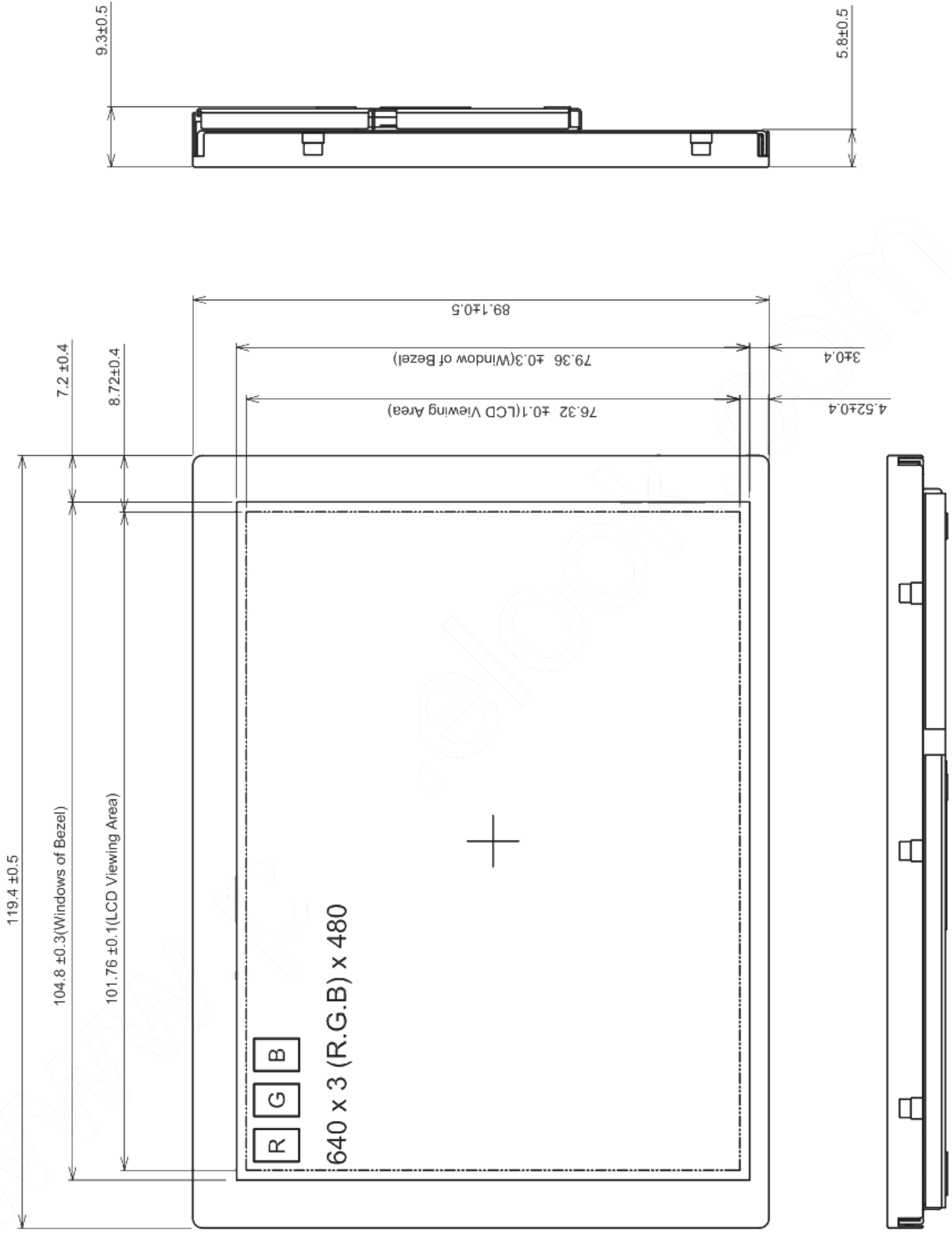
L/R : H , U/D : H

8.7 DATA INPUT for DISPLAY COLOR

| | COLOR & Gray Scale | Data Signal | | | | | | | | | | | | | | | | | |
|-------------|--------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (0) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (0) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue (0) | 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 (62) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (61) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Red (1) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (0) | 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 (62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Green (1) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (0) | 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 (62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue (61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : |
| | Blue (1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue (0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

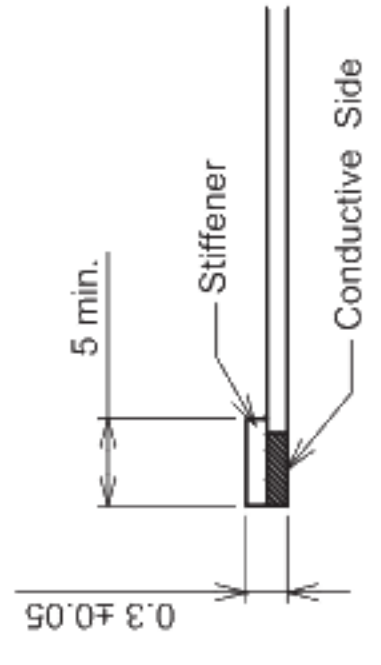
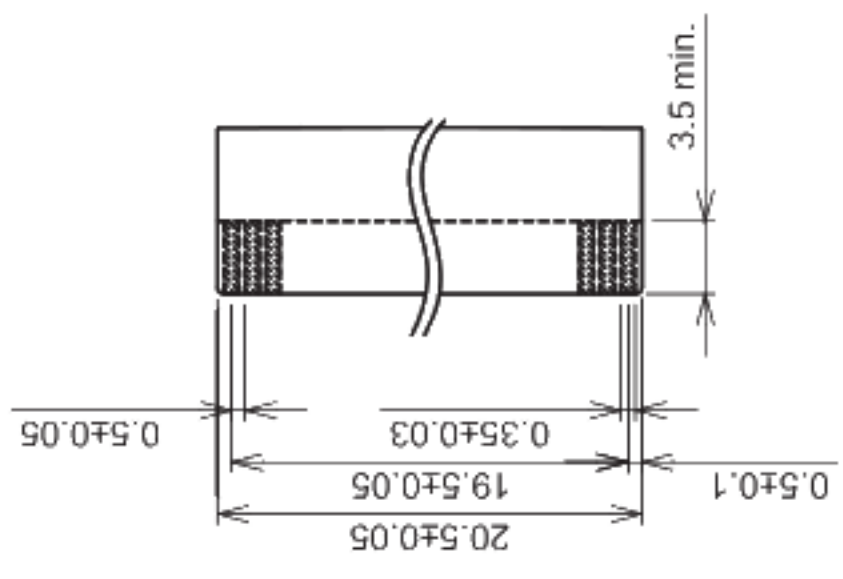
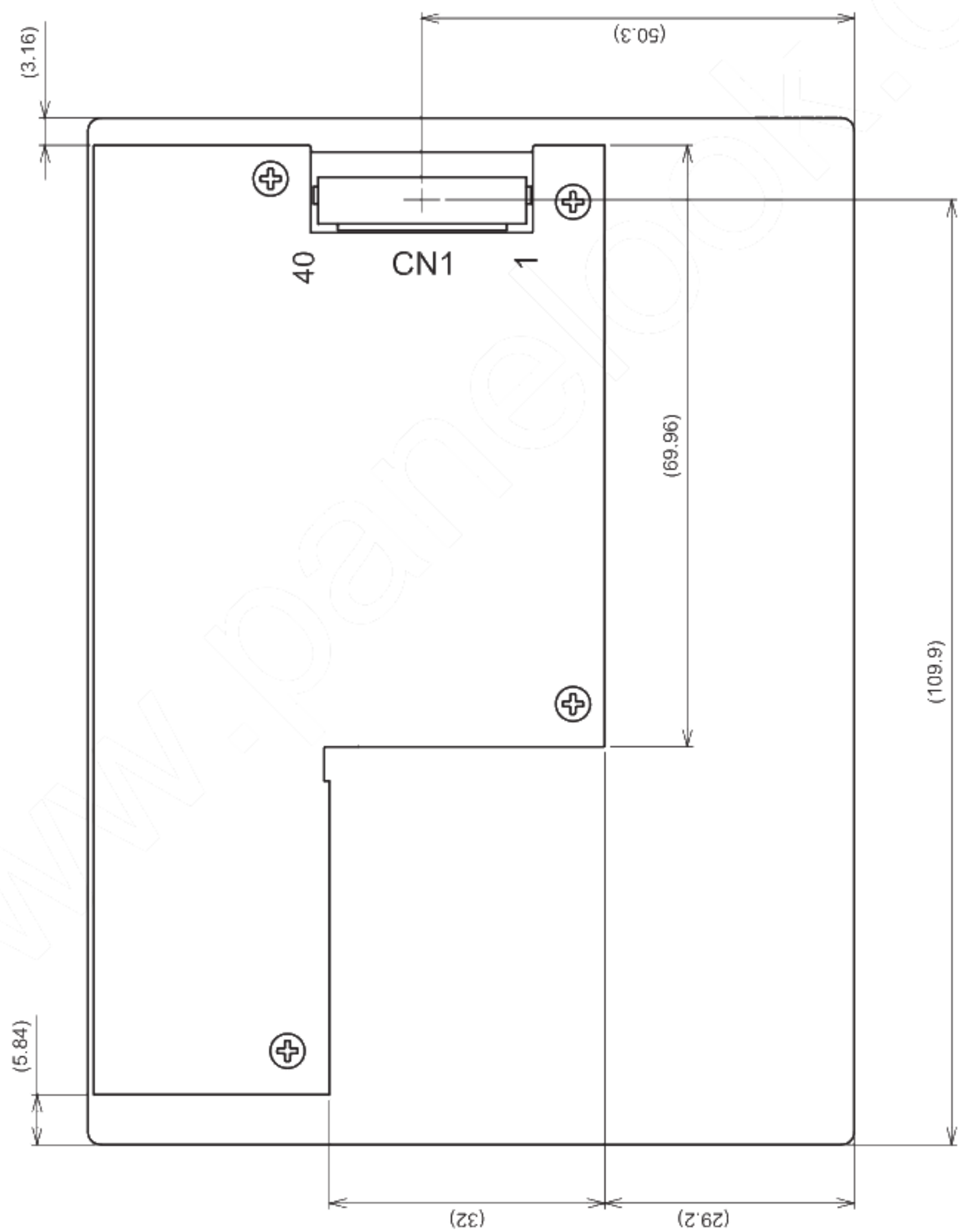
9. OUTLINE DIMENSIONS

9.1 FRONT VIEW



Scale : NTS
Unit : mm

9.2 REAR VIEW



Recommended design rule for CN1 FPC

Scale : NTS
Unit : mm