KOE

JDI Group

TENTATIVE

Kaohsiung Opto-Electronics Inc.

FOR MESSRS : _____ DATE : Sep. 9th ,2020

TECHNICAL DATA

TX14D203VM0BPA

Contents

ACCEPTED BY: _____ PROPOSED BY: Jolin Chou

2. RECORD OF REVISION

3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 5.7” VGA of 4:3 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 COG (chip on glass) technology and LED backlight are applied on this display.

Part Name	TX14D203VM0BPA
Module Dimensions	131.0(W) mm x 102.2(H) mm x 9.1(D) mm typ.
LCD Active Area	115.2(W) mm x 86.4(H) mm
Dot Pitch	0.06 x 3(R, G, B)(W) x 0.18(H) mm
Resolution	640 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	262k Colors
Backlight	27 LEDs (3 serial x 9 parallel)
Weight	145g typ.
Interface	C-MOS; 18-bit RGB; 40 pins
Power Supply Voltage	3.3V for LCD; 12V for Backlight
Power Consumption	429 mW for LCD ; 2.16W for Backlight
Viewing Direction	Super Wide Version (In-plane Switching)
Touch Panel	4-wire resistive type; Film on Glass; Antiglare surface

4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Remarks
Supply Voltage	V_{DD}	0	7.0	V	-
Input Voltage of Logic	V_I	-0.3	V_{DD}+0.3	V	Note 1
Operating Temperature	Top	-20	70	°C	Note 2
Storage Temperature	Tst	-30	80	°C	Note 2

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

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

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	V_{SS}	-	$0.3V_{DD}$		
Power Supply Current	I_{DD}	-	-	130	-	mA	Note 2
Vsync Frequency	f_v	-	-	60	-	Hz	-
Hsync Frequency	f_H	-	-	31.5	-	KHz	-
DCLK Frequency	f_{CLK}	-	-	25.2	-	MHz	-

Note 1: The rating is defined for the signal voltages of the interface such as DE, Hsync, Vsync, CLK 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: 0.4A fuse is applied in the module for I_{DD}. For display activation and protection purpose, power supply is recommended larger than 1.0A 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}	Backlight Unit	-	12.0	-	V	Note1
LED Forward Current	I_{LED}	Backlight Unit	-	180	-	mA	-
LED Lifetime	-	180 mA	-	50K	-	hrs	Note 2

Note 1: Fig. 5.1 shows the LED backlight circuit. The circuit has 27 LEDs in total and R is 130 Ω.

Note 2: The estimated lifetime is specified as the time to reduce 50% brightness by applying 180 mA at 25°C.

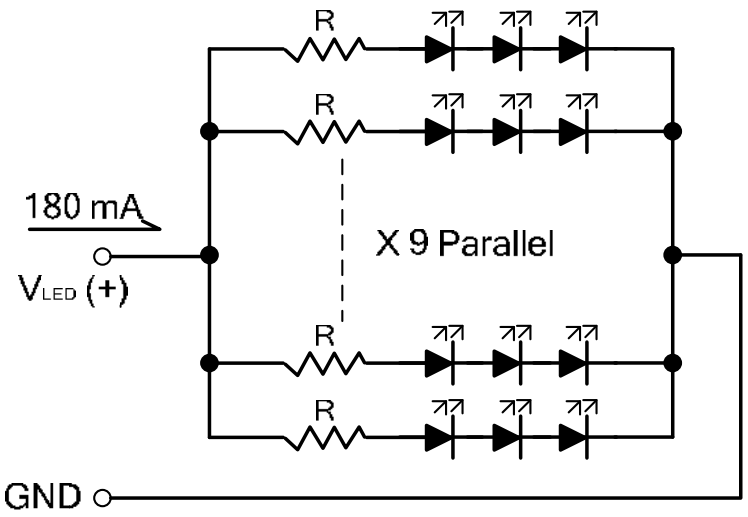


Fig. 5.1

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 °C, f_v = 60 Hz, V_{DD} = 3.3V

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Brightness of White		-	$\phi=0^\circ,\theta=0^\circ$, I_{LED}= 180mA	500	640	-	cd/m^2	Note 1
Brightness Uniformity		-		70	-	-	%	Note 2
Contrast Ratio		CR		-	1000	-	-	Note 3
Response Time (Rising + Falling)		Tr + Tf	$\phi=0^\circ,\theta=0^\circ$	-	25	-	ms	Note 4
NTSC Ratio		-	$\phi=0^\circ,\theta=0^\circ$	-	60	-	%	-
Viewing Angle		θ x	$\phi=0^\circ$, CR ≥ 10	-	85	-	Degree	Note 5
		θ x′	$\phi=180^\circ$, CR ≥ 10	-	85	-		
		θ y	$\phi=90^\circ$, CR ≥ 10	-	85	-		
		θ y′	$\phi=270^\circ$, CR ≥ 10	-	85	-		
Color Chromaticity	Red	X	$\phi=0^\circ,\theta=0^\circ$	-	0.62	-	-	Note 6
		Y		-	0.35	-		
	Green	X		-	034	-		
		Y		-	0.58	-		
	Blue	X		-	0.14	-		
		Y		-	0.07	-		
	White	X		-	0.30	-		
		Y		-	0.31	-		

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

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

$$\text{Brightness uniformity} = \frac{\text{Min. Brightness}}{\text{Max. Brightness}} \text{ X100\%}$$

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

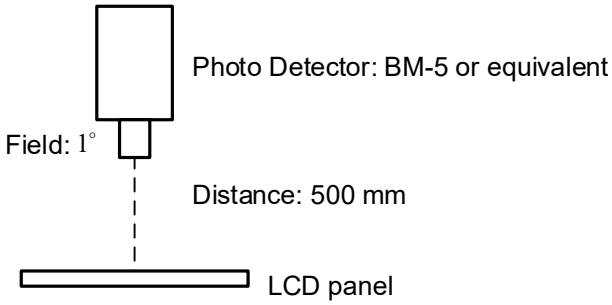


Fig. 6.1

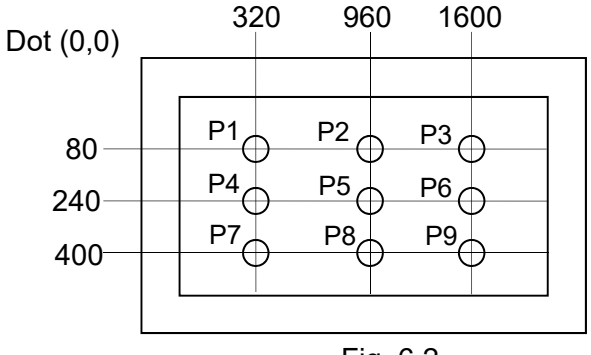


Fig. 6.2

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.

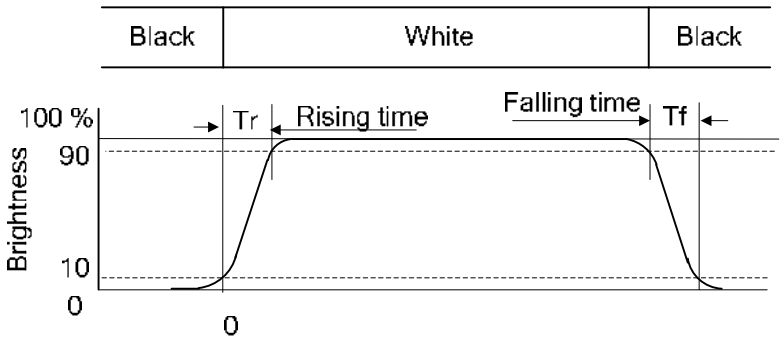


Fig 6.3

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

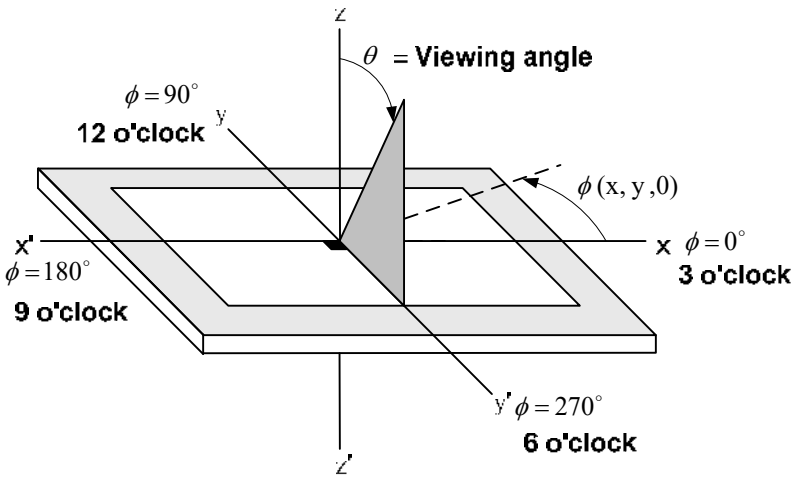
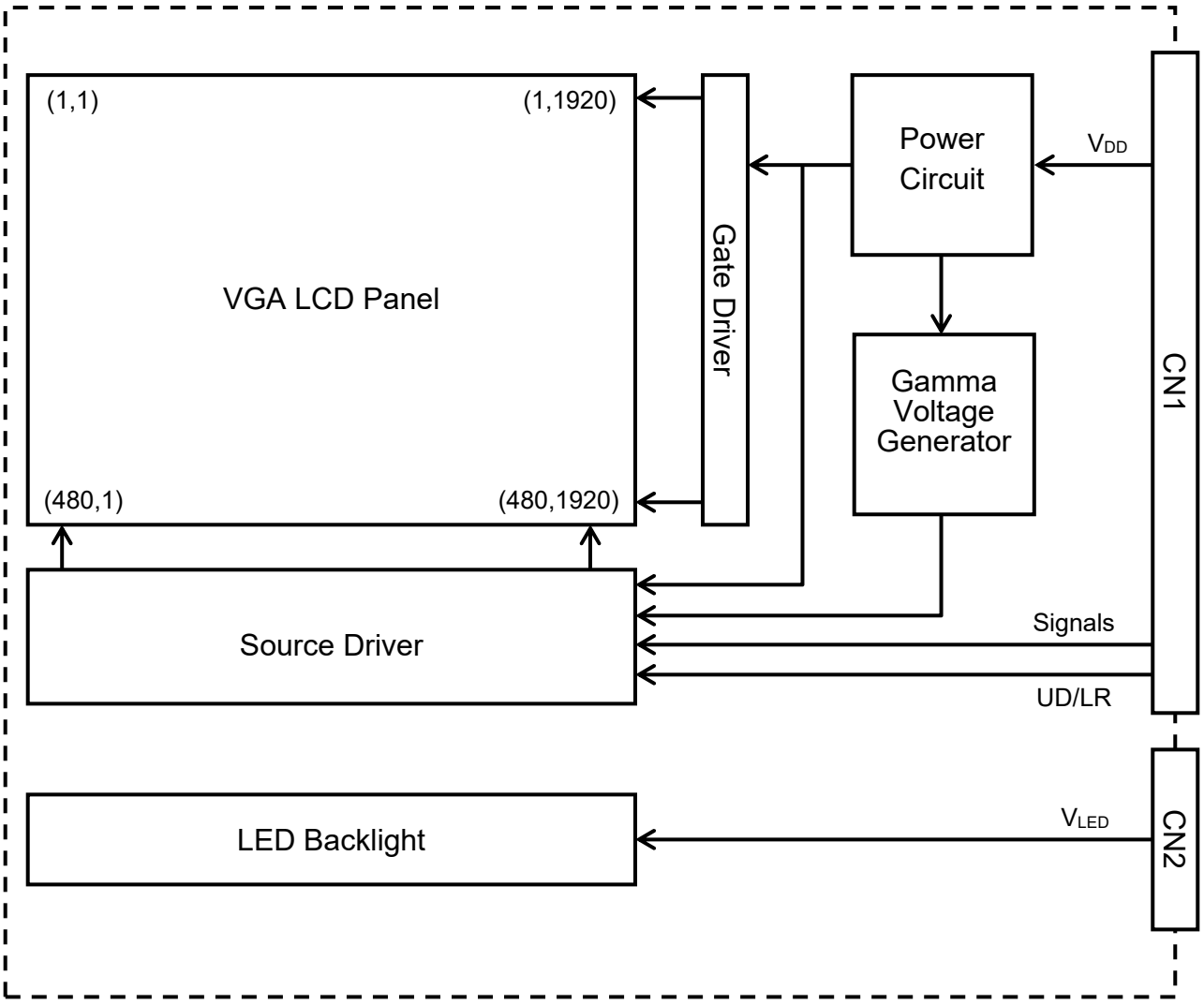


Fig. 6.4

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 DE, Hsync, Vsync, CLK and RGB data bus.

8. LCD INTERFACE

8.1 INTERFACE PIN CONNECTIONS

The display interface connector is FA5B040HP1R3000 made by JAE (Thickness: 0.3±0.05mm; Pitch: 0.5±0.05mm) and more details of the connector are shown in the section of outline dimension.

Pin assignment of LCD interface is as below:

Pin No.	Signal	Function	Pin No.	Signal	Function
1	V_{DD}	Power Supply for Logic	21	G4	Green Data
2	V_{DD}		22	G3	Green Data
3	UD	Vertical Display mode Control	23	V_{SS}	GND
4	LR	Horizontal Display mode Control	24	G2	Green Data
5	Vsync	Vertical synchronous signal	25	G1	Green Data
6	DE	Data Enable Signal	26	G0	Green Data (LSB)
7	V_{SS}	GND	27	V_{SS}	GND
8	CLK	Dot Clock	28	R5	Red Data (MSB)
9	V_{SS}	GND	29	R4	Red Data
10	Hsync	Horizontal synchronous signal	30	R3	Red Data
11	V_{SS}	GND	31	V_{SS}	GND
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}	GND	35	NC	No Connection
16	B2	Blue Data	36	V_{SS}	GND
17	B1	Blue Data	37	NC	No Connection
18	B0	Blue Data (LSB)	38	NC	
19	V_{SS}	GND	39	NC	
20	G5	Green Data (MSB)	40	NC	

Note 1: Please refer to 8.5 SCAN DIRECTION for the setting methods of UD, LR function.

Note 2: Synchronous or DE mode would be automatically selected when signal input.

The backlight interface connector is BHR-03VS-1 made by JAE, and pin assignment of backlight is as below:

Pin No.	Signal	Level	Function
1	V_{LED}+	-	Power Supply for LED
2	NC	-	No connection
3	V_{LED}-	-	GND

8.2 TIMING CHART

A. SYNCHRONOUS MODE (DE grounded)

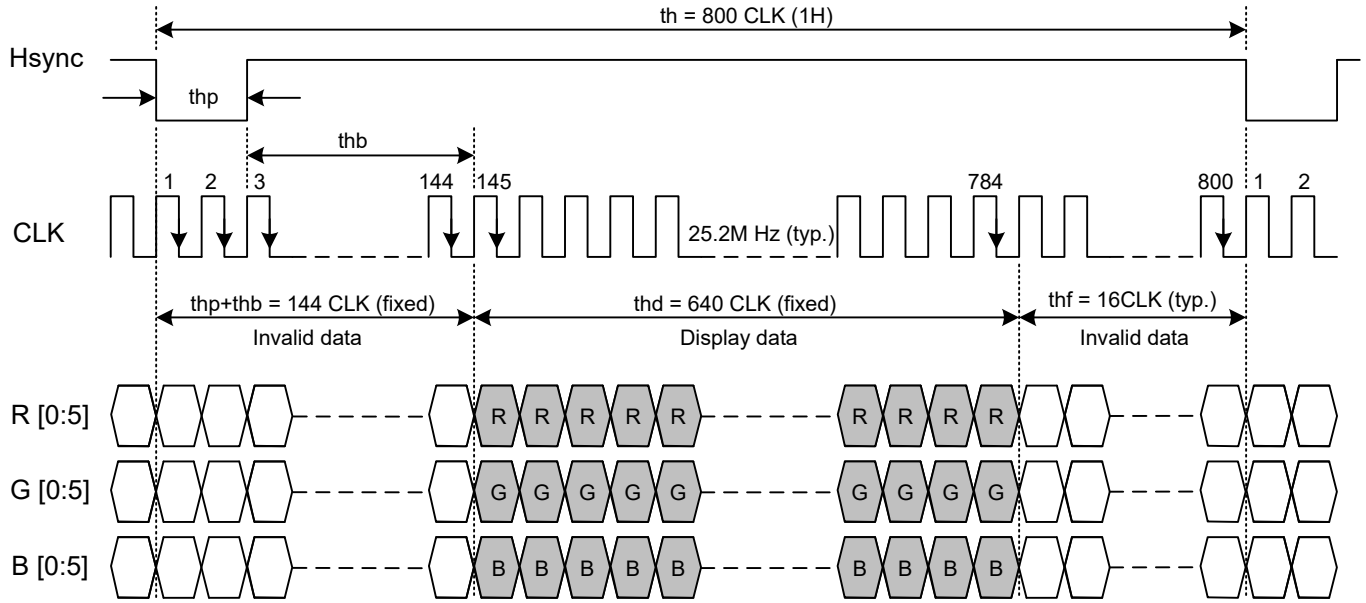


Fig. 8.1 Horizontal Timing of Synchronous Mode

Note 1: CLK's falling edge is the time to latch data and count (thp + thb), therefore, data sending and Hsync's falling edge should start when CLK's rise edge.

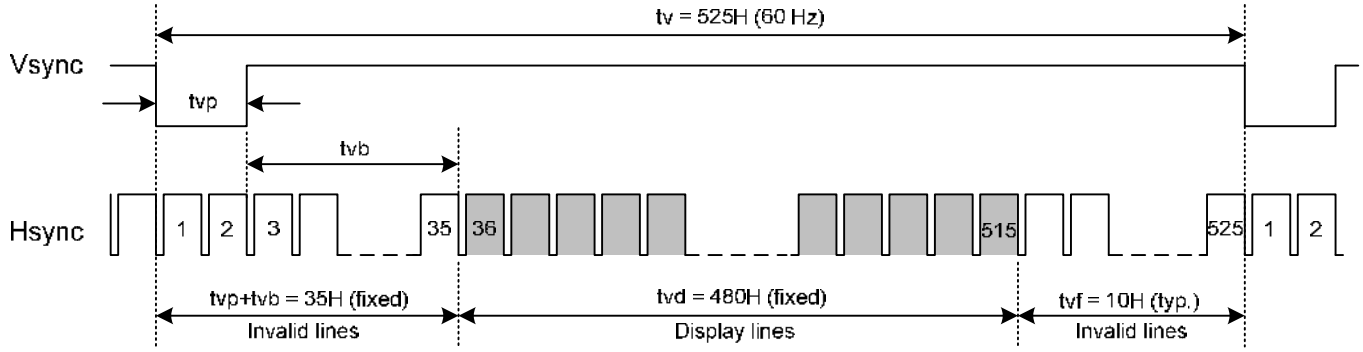


Fig. 8.2 Vertical Timing of Synchronous Mode

Note 2: Vsync's falling edge needs to start with Hsync's falling edge simultaneously to count (tvp + tvb).

B. DE MODE (Hsync & Vsync grounded)

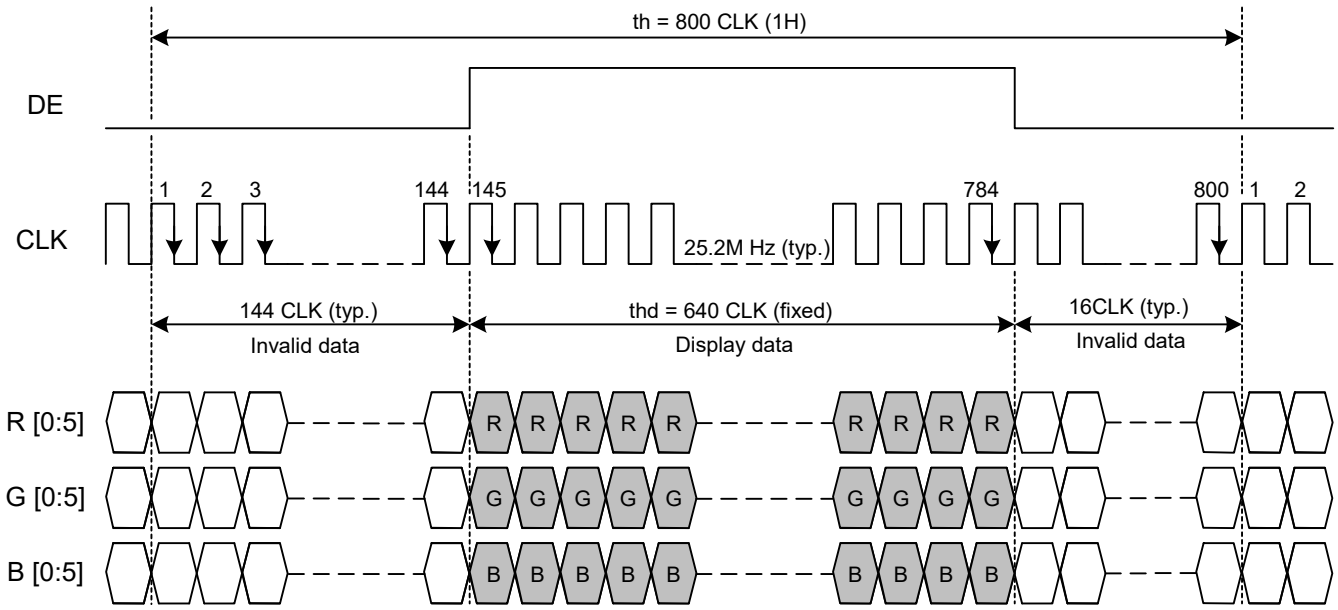


Fig. 8.3 Horizontal Timing of DE Mode

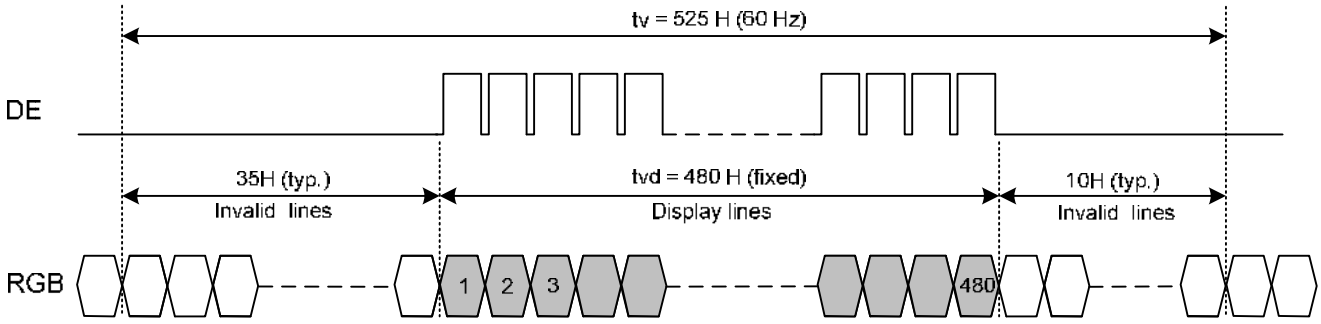


Fig. 8.4 Vertical Timing of DE Mode

C. CLOCK AND DATA INPUT TIMING

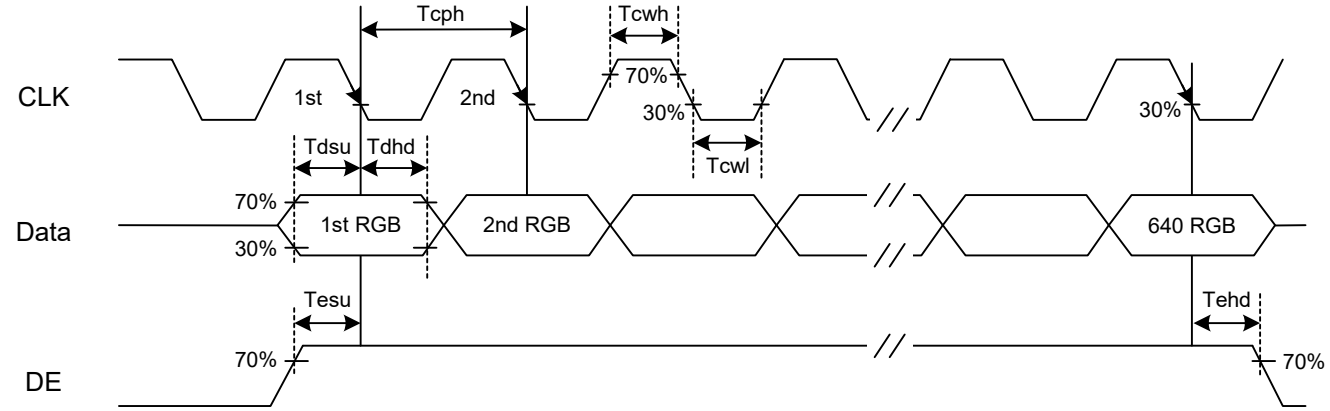


Fig. 8.5 Setup & Hold Time of Data and DE signal.

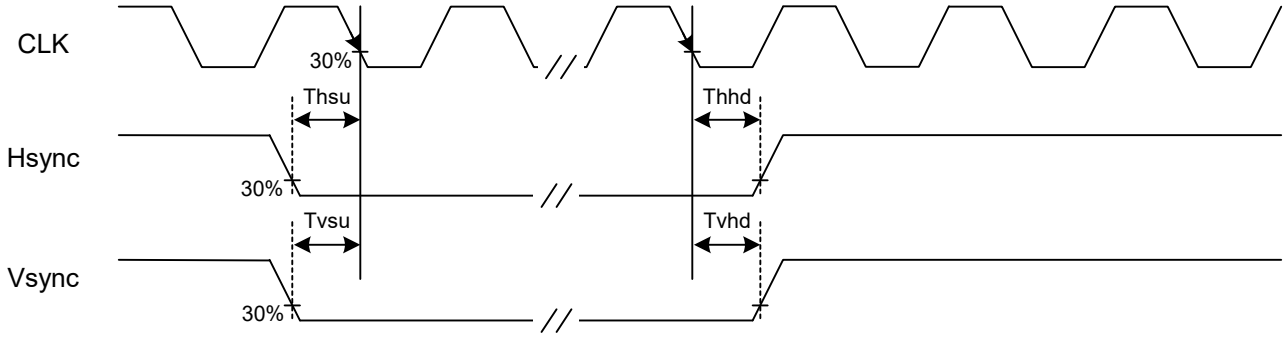


Fig. 8.6 Setup & Hold Time of Hsync and Vsync signal

8.3 TIMING TABLE

The column of timing sets including minimum, typical, and maximum as below are based on the best optical performance, frame frequency (Vsync) = 60Hz to define.

A. SYNCHRONOUS MODE

Item		Symbol	Min.	Typ.	Max.	Unit
Hsync	CLK Frequency	fclk	-	25.2	-	M Hz
	Display Data	thd	-	640	-	CLK
	Cycle Time	th	-	800	-	
	Pulse Width	thp	-	30	-	
	Pulse Width and Back Porch	thp + thb	-	144	-	
	Front Porch	thf	-	16	-	
Vsync	Display Line	tvd	-	480	-	H
	Cycle Time	tv	-	525	-	
	Pulse Width	tvp	-	3	-	
	Pulse Width and Back Porch	tvp + tvb	-	35	-	
	Front Porch	tvf	-	10	-	

B. DE MODE

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

C. CLOCK AND DATA INPUT TIMING

Item		Symbol	Min.	Typ.	Max.	Unit
CLK	Duty	Tcwh	40	50	60	%
	Cycle Time	Tcph	-	39.68	-	ns
Vsync	Setup Time	Tvsu	10	-	-	
	Hold Time	Tvhd	10	-	-	
Hsync	Setup Time	Thsu	10	-	-	
	Hold Time	Thhd	10	-	-	
Data	Setup Time	Tdsu	10	-	-	
	Hold Time	Tdhd	10	-	-	
DE	Setup Time	Tesu	10	-	-	
	Hold Time	Tehd	10	-	-	

8.4 POWER SEQUENCE

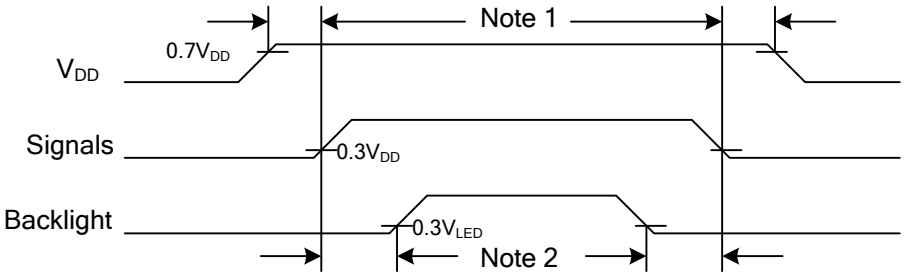


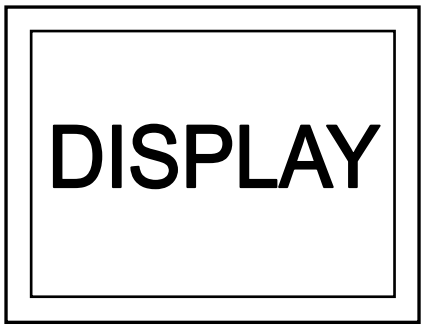
Fig. 8.7 Power Sequence Timing

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.

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.

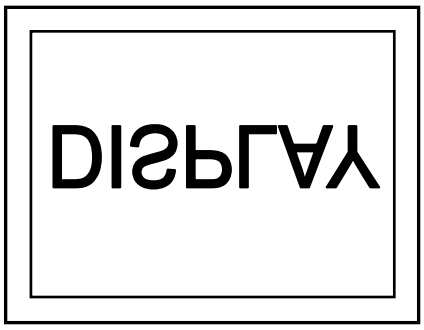
8.5 SCAN DIRECTION

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

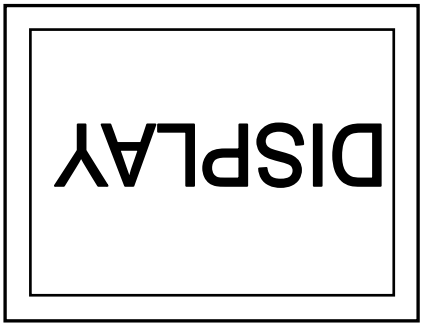


UD：H；LR：H

UD：H；LR：L



UD：L；LR：H



UD：L；LR：L

8.6 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 (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
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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
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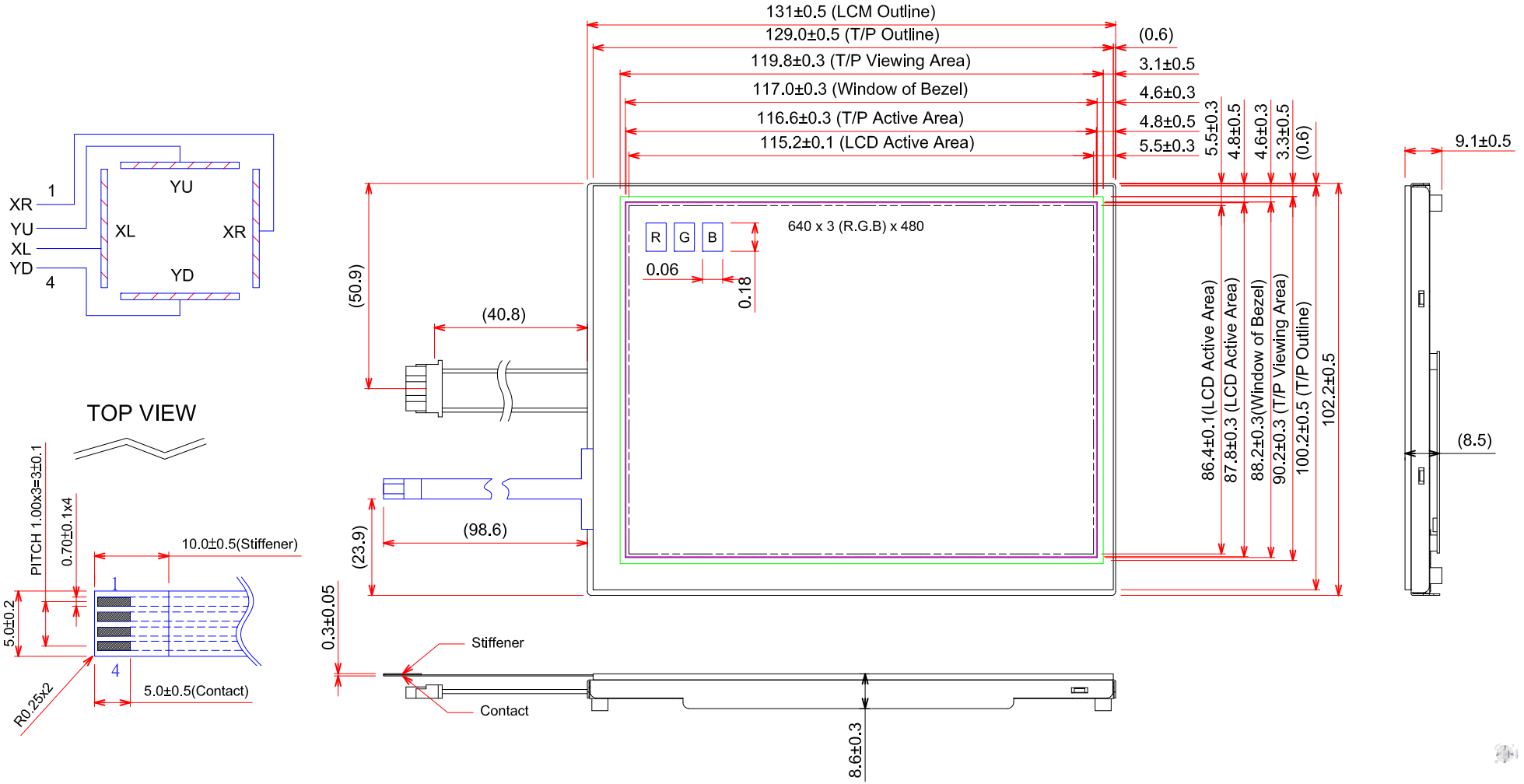
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

9. OUTLINE DIMENSIONS

9.1 FRONT VIEW



Scale : NTS
Unit : mm

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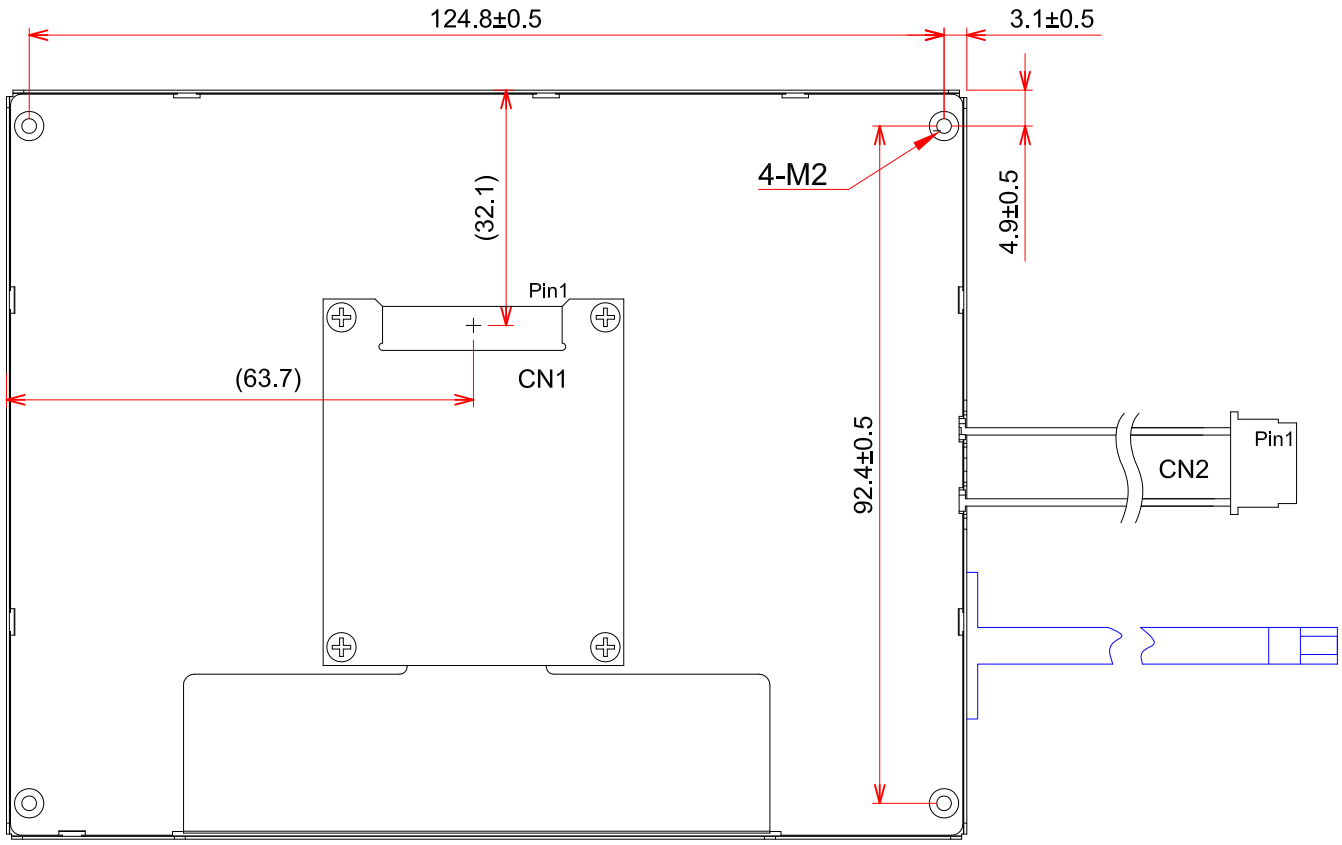
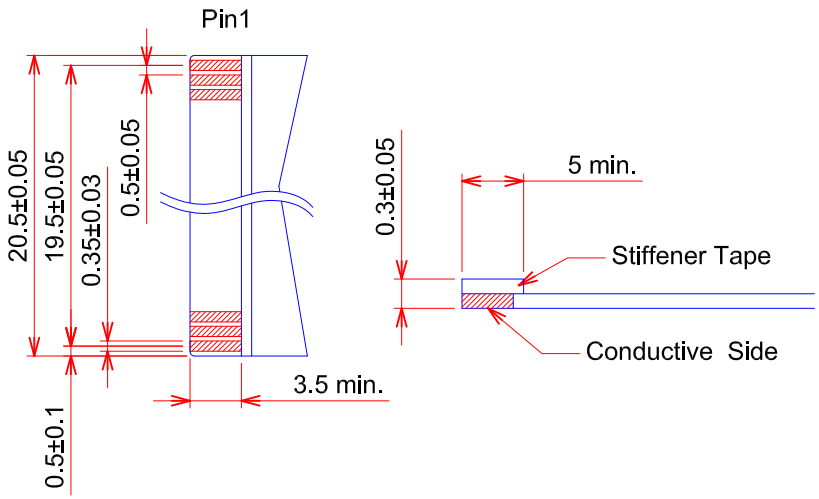
9.2 REAR VIEW



Recommended design rule for CN1 FPC



Note 1) CN1 : FA5B040HP1R3000
CN2 : BHR-03VS-1(JST)

Scale : NTS
Unit : mm

10. 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:

10.1 OPERATING CONDITIONS

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

10.2 ELECTRICAL CHARACTERISTICS

Item		Specification	Remarks
Circuit resistance	X- axis	300Ω~1100Ω	-
	Y-axis	100Ω~800Ω	
Insulation Resistance	X-Y	>20MΩ	At DC 25V
Linearity	X	≤ ± 1.5%	Note 1
	Y	≤ ± 1.5%	
Chattering		≤10 ms	-

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. 10.1

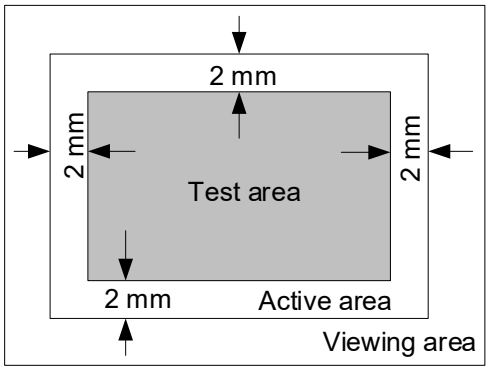


Fig. 10.1

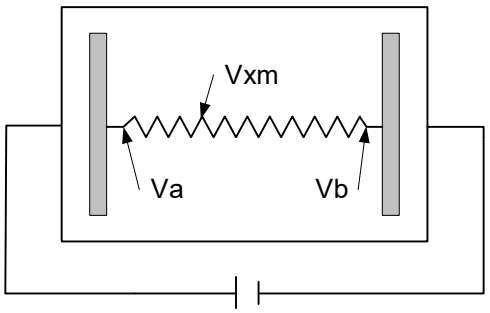


Fig. 10.2

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.

10.3 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

10.4 OPTICAL CHARACTERISTICS

Item	Specification	Remarks
Transmittance	77%	-

10.5 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.