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Mechanical design





TENTATIVE

FOR MESSRS : _____

DATE : Dec. 11th, 2023

TECHNICAL DATA

TX40D202VM0BAA

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ACCEPTED BY : _____

PROPOSED BY : Max Lee

2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY

3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 15.6" FHD 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, COG (chip on glass) technology and LED backlight are applied on this display.

Part Name	TX40D202VM0BAA
Module Dimensions	367.86(W) mm x 219.51(H) mm x 14.71 (D) mm
LCD Active Area	344.16(W) mm x 193.59(H) mm
Pixel Pitch	0.1792(W) mm x 0.1792 (H) mm
Resolution	1920 x 3(RGB)(W) x 1080(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	670g
Interface	2ch-LVDS; 50 pins
Power Supply Voltage	5.0V for LCD; 12V for Backlight
Power Consumption	1.5W for LCD , 25.2W for Backlight
Viewing Direction	Super Wide Version

4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Remarks
Supply Voltage	V _{DD}	-0.3	6.0	V	-
Input Voltage of Logic	V _I	-0.3	V _{DD} +0.3	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}	-0.3	15	V	-
Backlight Voltage for PWM	V _{PWM}	-0.3	5	V	-
Backlight Voltage for EN	V _{EN}	-0.3	5	V	-

Note 1: The rating is defined for the signal voltages of the interface such as CLK and data pairs.

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 OPERATING CONDITIONS

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

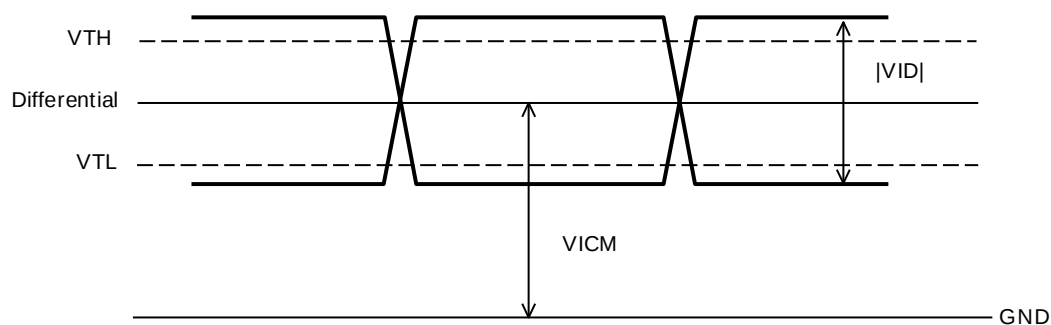
Item	Symbol	Condition	Standard Value			Unit	Remarks
			Min.	Typ.	Max.		
Power Supply Voltage	V_{DD}	-	4.7	5.0	5.0	V	-
Power Supply Current	I_{DD}	Note 1	-	313	-	mA	Note 1,4
Allowable Ripple Voltage	VRP	-	-	-	100	mV (p-p)	Note 2
Differential Input High Threshold	VTH	$V_{ICM}=1.2\text{V}$	-	-	100	mV	Note 3
Differential Input Low Threshold	VTL	$V_{ICM}=1.2\text{V}$	-100	-	-	mV	
Input Differential Voltage	$ V_{ID} $	-	200	400	600	mV	
Differential Input Common Mode Voltage	V_{ICM}	-	$V_{ID}/2$	1.2	$2.25-(V_{ID}/2)$	V	

Note 1: Measurement pattern: All white.

Power supply voltage: Typ. voltage.

Note 2: Applied pin is $\{V_{DD}\}$

Note 3: Signal of interest is LVDS.



Note 4: (TBD) fuse is applied in the module for I_{DD} . For display activation and protection purpose, power supply is recommended larger than (TBD) 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}	$I_{LED}=2100\text{mA}$	-	12	-	V	Note 1
LED Forward Current	I_{LED}	100% duty	-	2100	-	mA	Note 2
		0% duty	-	(TBD)	-		
PWM Signal Voltage	-	High	1.2	-	3.3	V	-
		Low	-	-	0.4		
		Range	3	-	100	%	Note 4
EN Voltage	V_{EN}	-	1.6	-	3.3	V	-
LED Lifetime	-	$I_{LED}=2100\text{mA}$	-	70K	-	hrs	Note 3

Note 1: Fig. 5.1 shows the LED backlight circuit.

Note 2: Dimming function can be obtained by applying PWM signal from the display interface CN2. The recommended PWM signal is 200Hz ~ 10KHz with 3.3 V amplitude.

Note 3: The estimated lifetime is specified as the time to reduce 50% brightness by applying 1050mA at 25°C.

Note 4: Lower PWM duty may cause the unstable flicking or current. Please evaluate in advance if operating under 3%.

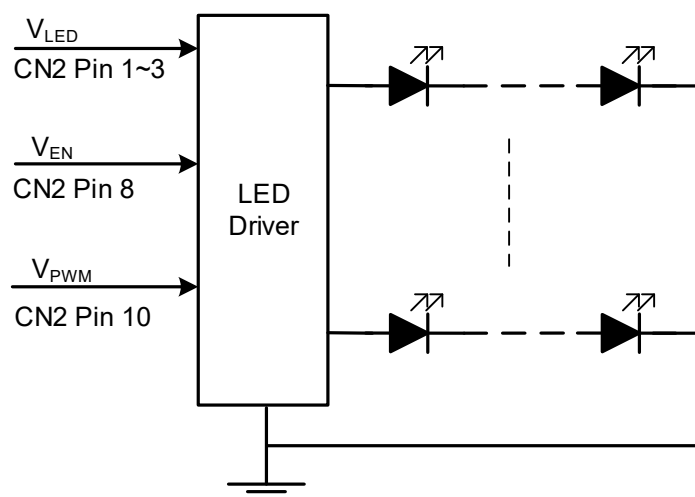


Fig 5.1

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 100 lx, 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		-	$\phi = 0^{\circ}, \theta = 0^{\circ},$ $I_{LED} = 2100\text{ mA}$	1200	1500	-	cd/m ²	Note 1
Brightness Uniformity		-		70	-	-	%	Note 2
Contrast Ratio		CR		700	1200	-	-	Note 3
Response Time		$T_r + T_f$	$\phi = 0^{\circ}, \theta = 0^{\circ}$	-	30	-	ms	Note 4
NTSC Ratio		-	$\phi = 0^{\circ}, \theta = 0^{\circ}$	-	80	-	%	-
Viewing Angle		θ_x	$\phi = 0^{\circ}, CR \geq 10$	-	85	-	Degree	Note 5
		$\theta_{x'}$	$\phi = 180^{\circ}, CR \geq 10$	-	85	-		
		θ_y	$\phi = 90^{\circ}, CR \geq 10$	-	85	-		
		$\theta_{y'}$	$\phi = 270^{\circ}, CR \geq 10$	-	85	-		
Color Chromaticity	Red	X	$\phi = 0^{\circ}, \theta = 0^{\circ}$	0.62	0.67	0.72	-	Note 6
		Y		0.26	0.31	0.36		
	Green	X		0.22	0.27	0.32		
		Y		0.57	0.62	0.67		
	Blue	X		0.10	0.15	0.2		
		Y		0.04	0.09	0.14		
	White	X		0.24	0.29	0.34		
		Y		0.26	0.31	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 measured by BM-5 as shown in Fig. 6.2.

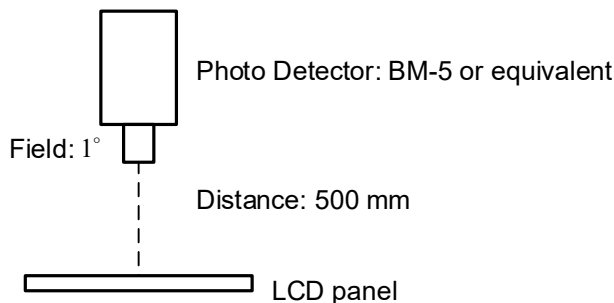


Fig. 6.1

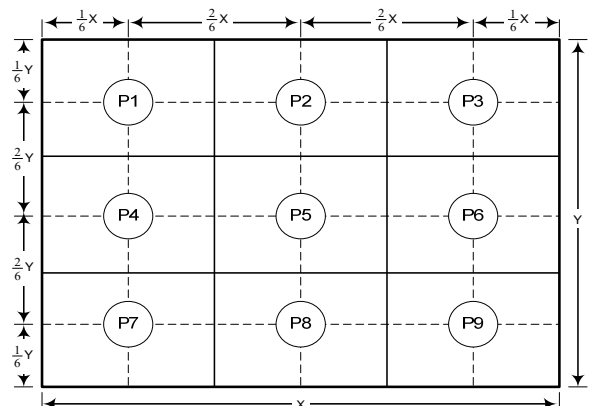


Fig. 6.2

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.

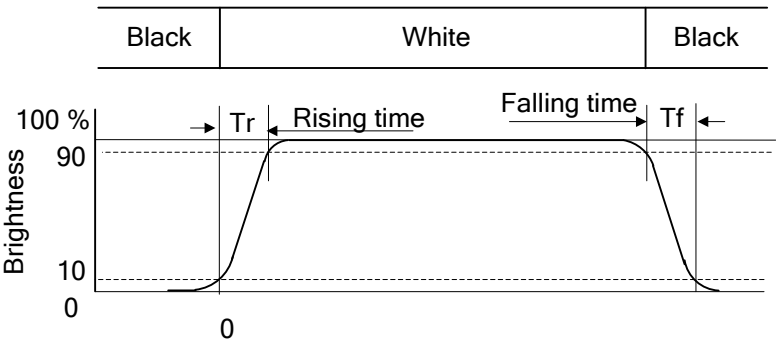


Fig 6.3

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

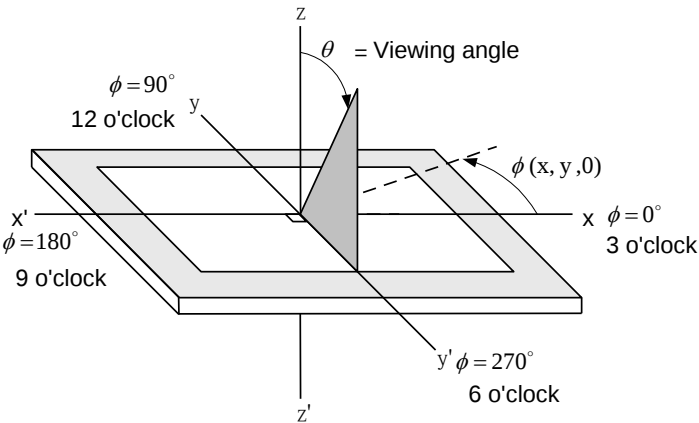
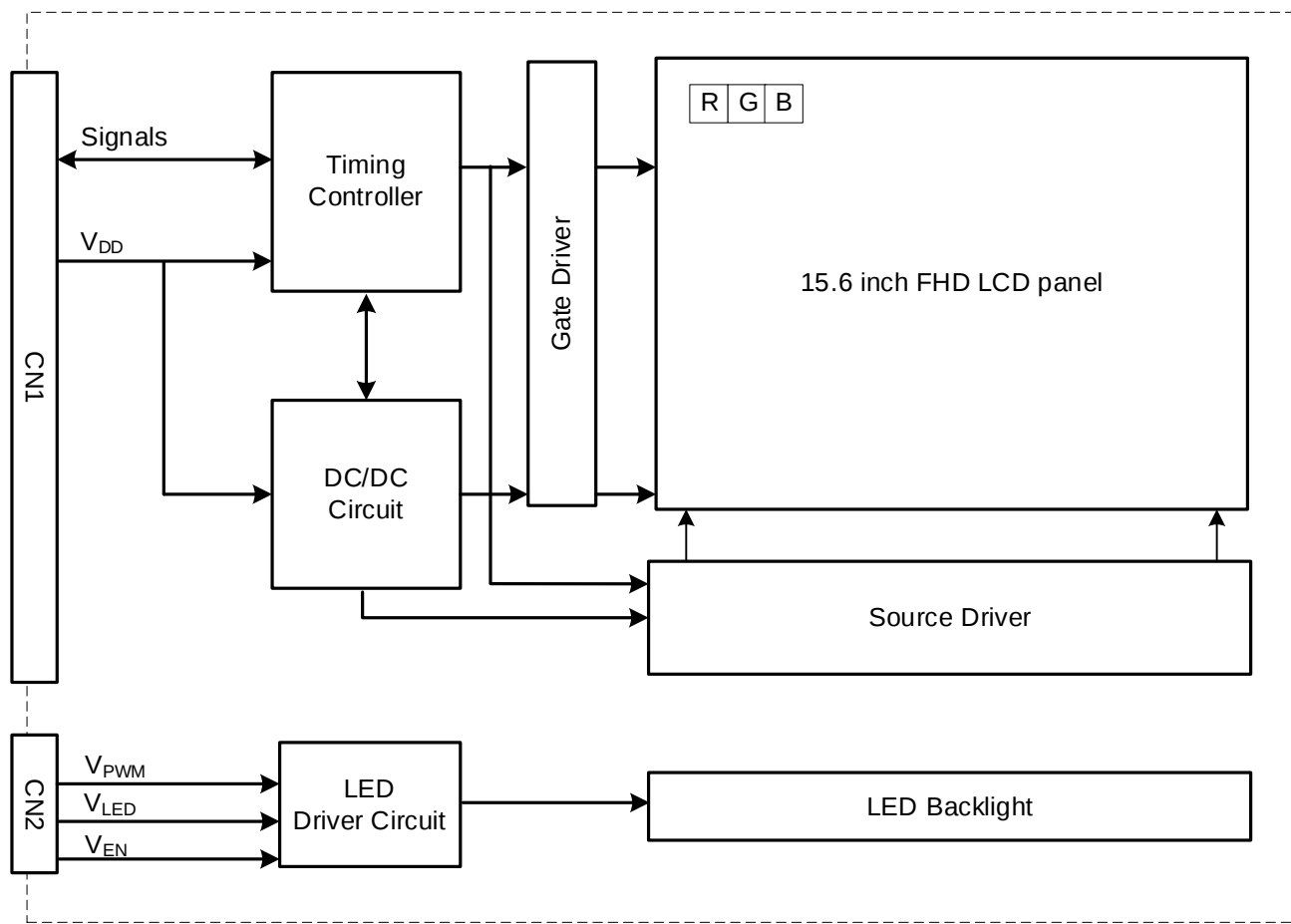


Fig 6.4

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

7. BLOCK DIAGRAM



Note1: Signals are EN,CLK and pixel data pairs.

8. LCD INTERFACE

8.1 INTERFACE PIN CONNECTIONS

The display interface connector CN1 is FH28-50S-0.5SH (Hirose), and Pin assignment is as below:

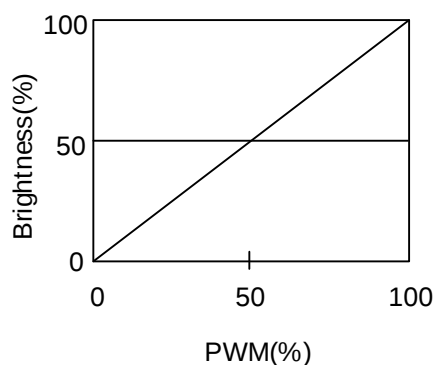
No	Symbol	Function	I/O
1	GND	GND (0V)	I
2	NC	Not connected	-
3	VDD	+5.0V Power Supply for Logic	I
4	VDD		
5	VDD		
6	NC	Not connected	-
7	GND	GND (0V)	I
8	GND		
9	GND		
10	ORXIN0 -	-LVDS differential data input, Chan 0-odd	I
11	ORXIN0+	+LVDS differential data input, Chan 0-odd	I
12	ORXIN1-	-LVDS differential data input, Chan 1-odd	I
13	ORXIN1+	+LVDS differential data input, Chan 1-odd	I
14	ORXIN2-	-LVDS differential data input, Chan 2-odd	I
15	ORXIN2+	+LVDS differential data input, Chan 2-odd	I
16	ORXCLKIN-	-LVDS clock input(odd)	I
17	ORXCLKIN+	+LVDS clock input(odd)	I
18	ORXIN3 -	-LVDS differential data input, Chan 3-odd	I
19	ORXIN3 +	+LVDS differential data input, Chan 3-odd	I
20	ERXIN0-	-LVDS differential data input, Chan 0-Even	I
21	ERXIN0+	+LVDS differential data input, Chan 0-Even	I
22	ERXIN1-	-LVDS differential data input, Chan 1-Even	I
23	ERXIN1+	+LVDS differential data input, Chan 1-Even	I
24	ERXIN2-	-LVDS differential data input, Chan 2-Even	I
25	ERXIN2+	+LVDS differential data input, Chan 2-Even	I
26	ERXCLKIN-	-LVDS clock input(Even)	I
27	ERXCLKIN+	+LVDS clock input(Even)	I
28	ERXIN3-	-LVDS differential data input, Chan 3-Even	I
29	ERXIN3+	+LVDS differential data input, Chan 3-Even	I
30	GND	GND (0V)	I

No	Symbol	Function	I/O
31	NC	Not connected	-
32	NC		-
33	EN	Enable input (3.3V)	I
34	NC	Not connected	-
35	NC		
36	NC		
37	NC		
38	GND	GND (0V)	I
39	GND		
40	NC	Not connected	I
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			

The interface CN2 is SM15B-SRSS-TB(LF)(SN) made by JST and pin assignment is as below:

Connector Name	Pin No.	Symbol	Function
SM15B-SRSS-TB(LF)(SN)	1	$V_{LED}(+)$	Power Supply for LED
	2	$V_{LED}(+)$	Power Supply for LED
	3	$V_{LED}(+)$	Power Supply for LED
	4	NC	No Connected
	5	$V_{LED}(-)$	GND
	6	$V_{LED}(-)$	GND
	7	$V_{LED}(-)$	GND
	8	V_{EN}	Backlight On/Off
	9	NC	No Connected
	10	V_{PWM}	Brightness dimming
	11	NC	No Connected
	12	NC	No Connected
	13	NC	No Connected
	14	NC	No Connected
	15	NC	No Connected

Note 1: The relationship of brightness and Dim control are shown as below.



8.2 TIMING CHART

Horizontal timing

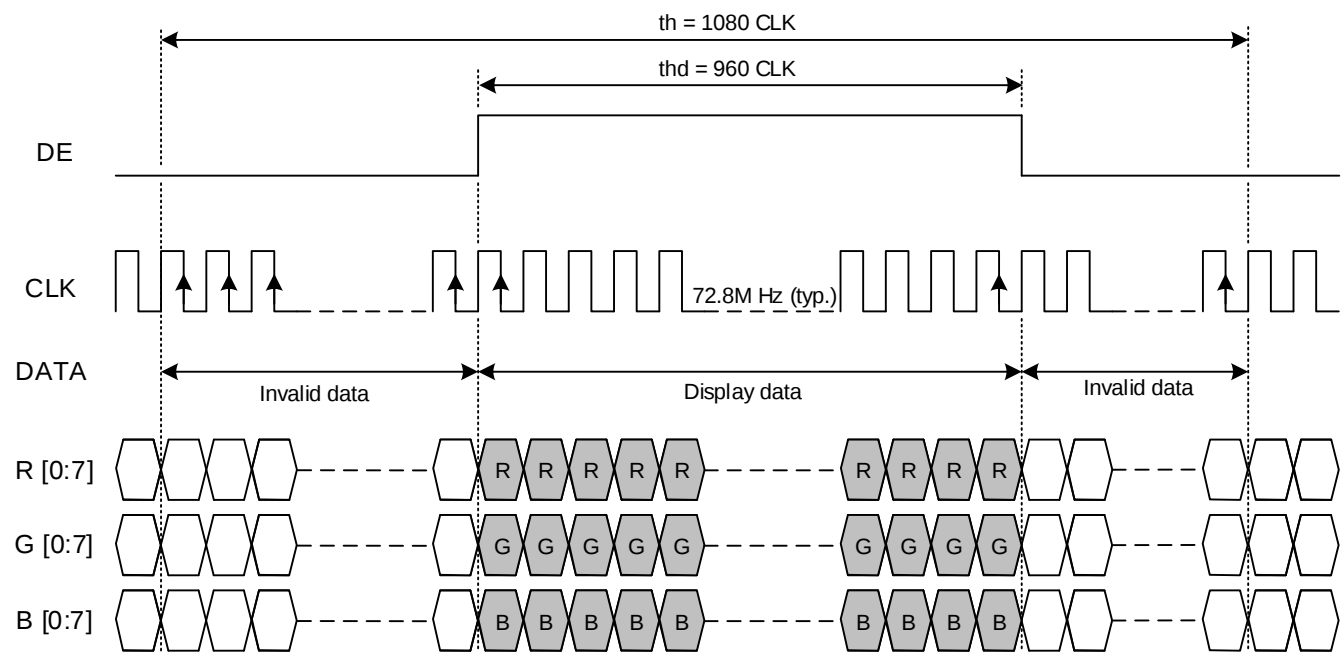


Fig. 8.1 Horizontal Timing of Synchronous Mode

Vertical timing

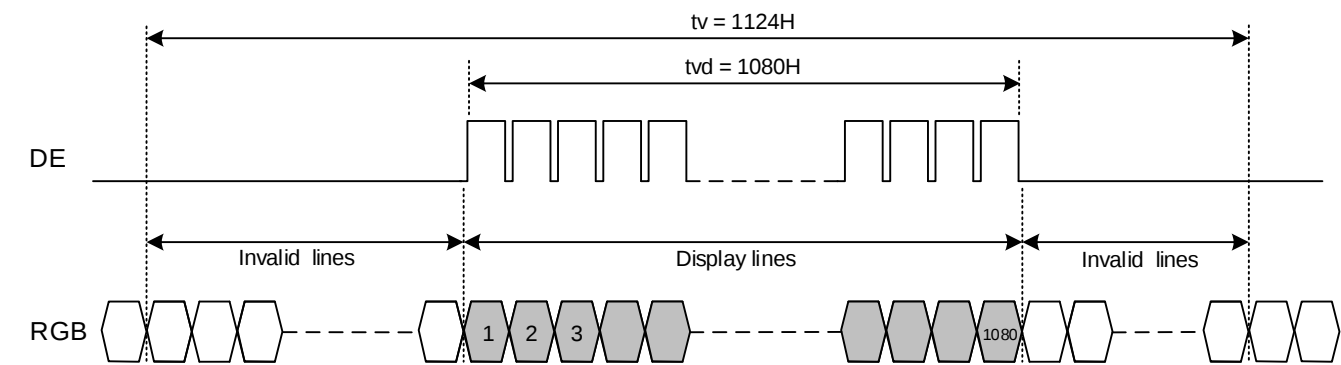


Fig. 8.2 Vertical Timing of Synchronous Mode

8.3 TIMING TABLE

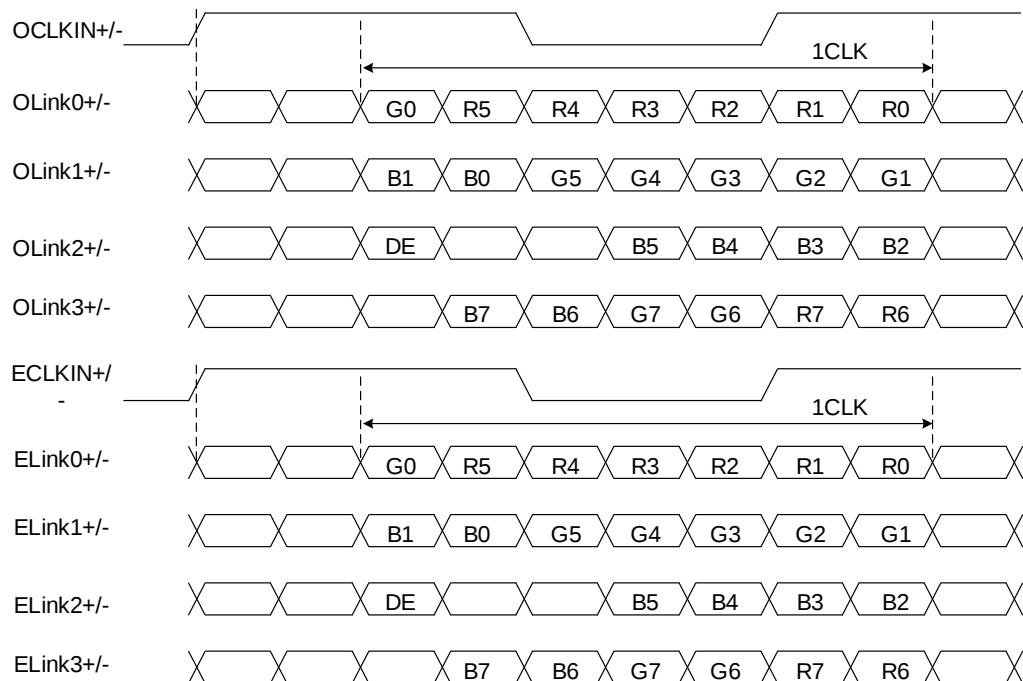
The column of timing sets including minimum, typical, and maximum as below are based on the best optical performance, frame frequency (f_{Frame}) = 60 Hz to define.

Item		Symbol	Min.	Typ.	Max.	Unit
Clock	CLK Frequency	fclk	-	72.8	-	M Hz
Hsync	Display Data	thd	1080			DCLK
	Cycle Time	thp	120			
	Display Line	tvd	1080			
	Cycle Time	tvp	44			
	Frame Frequency	f _{Frame}	-	60	-	Hz

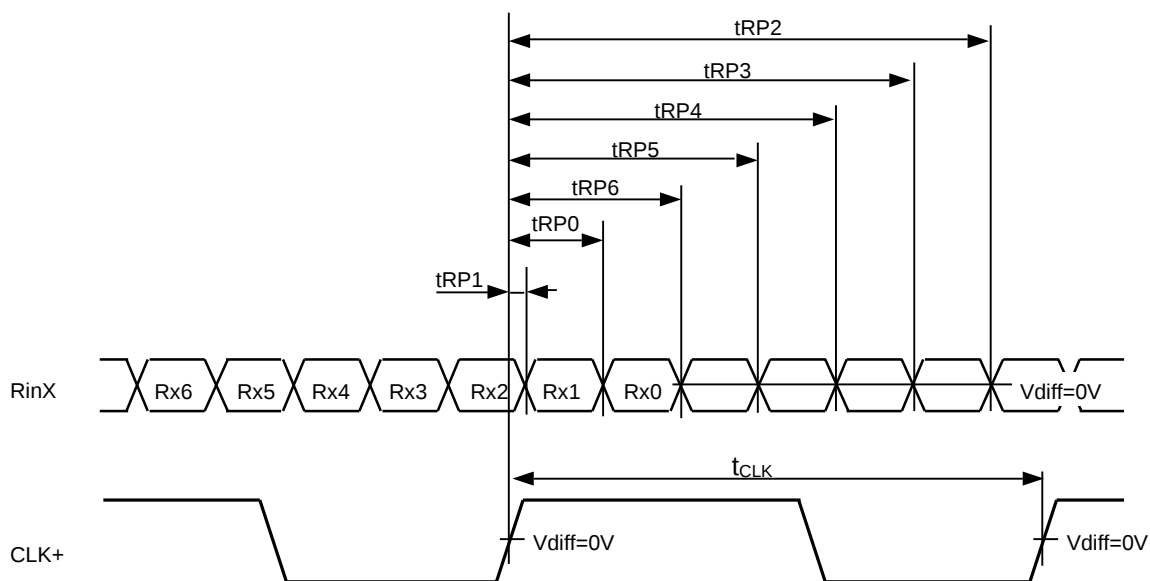
Note 1: For 2-port input, horizontal display period has the notation of the half of 1920.

8.4 LVDS Sequence

LVDS data format (VESA format)



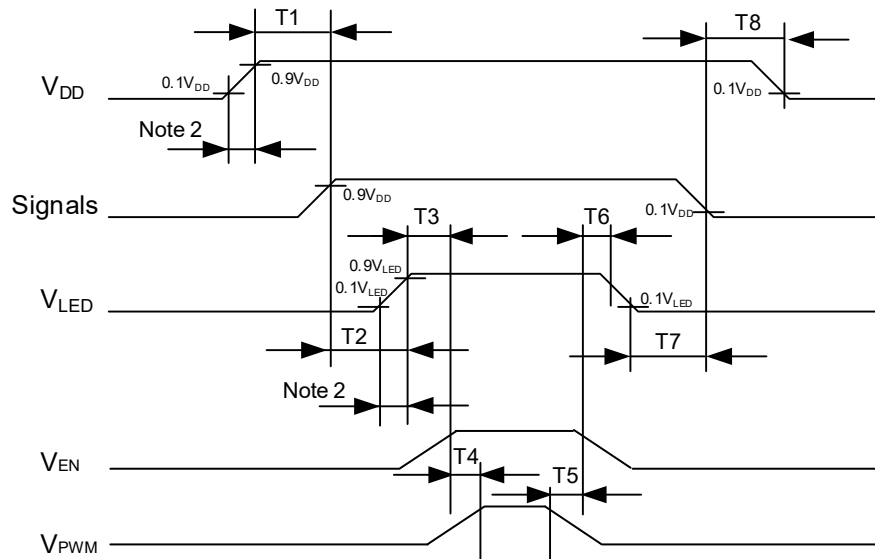
DE: Display Enable



$$\text{RinX} = (\text{RinX}+) - (\text{RinX}-) \quad (\text{X}=0, 1, 2, 3)$$

	Item	Symbol	Min.	Typ.	Max.	Unit
CLK	Cycle frequency	1/tCLK	-	72.8	-	MHz
RinX (X=0,1,2,3)	0 data position	tRP0	$1/7 * t_{\text{CLK}} - 0.3$	$1/7 * t_{\text{CLK}}$	$1/7 * t_{\text{CLK}} + 0.3$	ns
	1st data position	tRP1	-0.3	0	+0.3	
	2nd data position	tRP2	$6/7 * t_{\text{CLK}} - 0.3$	$6/7 * t_{\text{CLK}}$	$6/7 * t_{\text{CLK}} + 0.3$	
	3rd data position	tRP3	$5/7 * t_{\text{CLK}} - 0.3$	$5/7 * t_{\text{CLK}}$	$5/7 * t_{\text{CLK}} + 0.3$	
	4th data position	tRP4	$4/7 * t_{\text{CLK}} - 0.3$	$4/7 * t_{\text{CLK}}$	$4/7 * t_{\text{CLK}} + 0.3$	
	5th data position	tRP5	$3/7 * t_{\text{CLK}} - 0.3$	$3/7 * t_{\text{CLK}}$	$3/7 * t_{\text{CLK}} + 0.3$	
	6th data position	tRP6	$2/7 * t_{\text{CLK}} - 0.3$	$2/7 * t_{\text{CLK}}$	$2/7 * t_{\text{CLK}} + 0.3$	

8.5 Power ON/OFF sequence



Note 1: In order to avoid showing uncompleted patterns in transient state. The sequence is recommended as below:

$$0 \text{ sec} \leq T1, T3, T5, T6, T7, T8 \leq 1 \text{ sec}$$

$$0.5 \text{ sec} \leq T2 \leq 1 \text{ sec}$$

$$1 \text{ sec} \leq T4$$

Note 2: In order to avoid high Inrush current, V_{DD} rising time need to set more than 0.5ms.

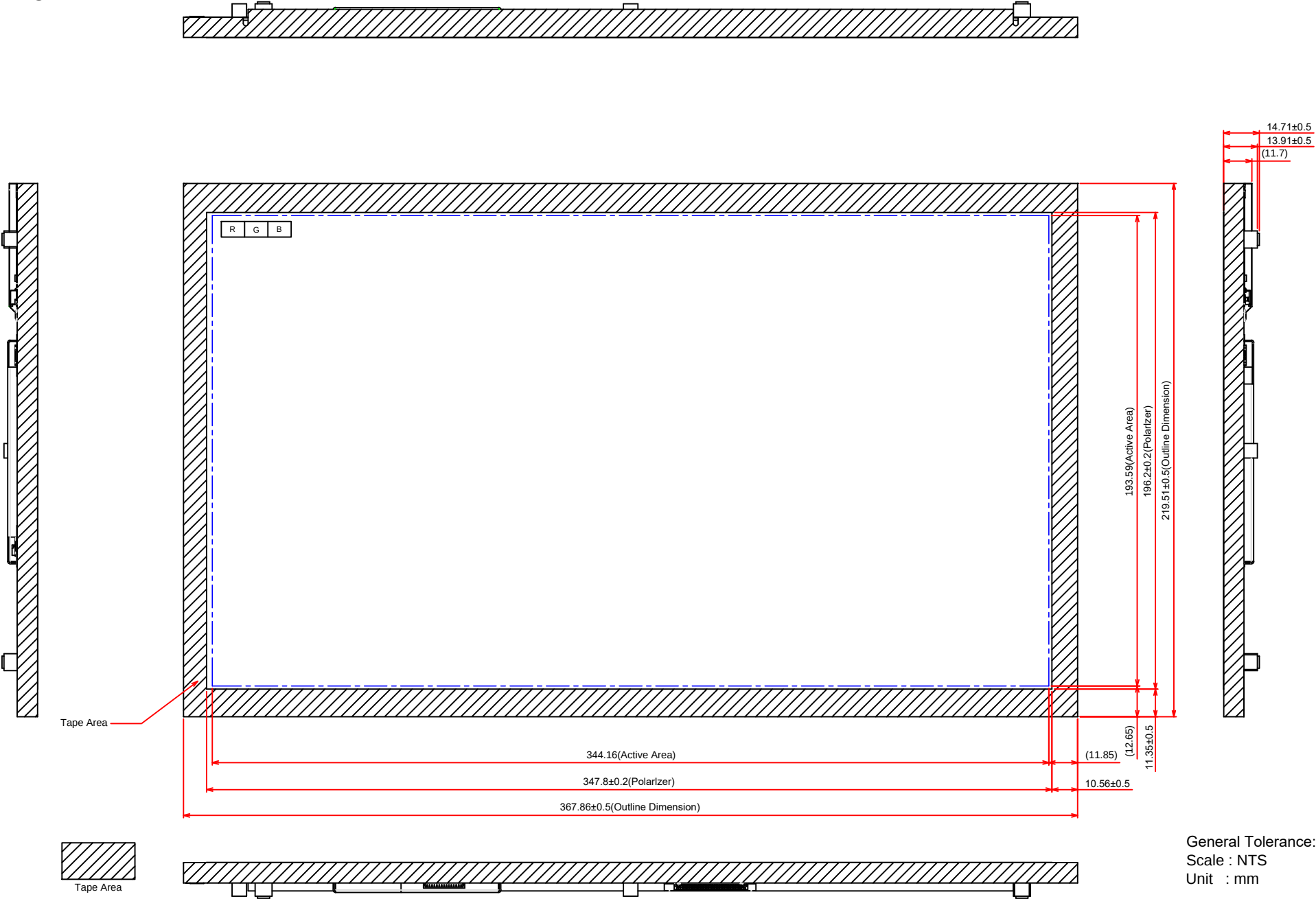
8.6 DATA INPUT for DISPLAY COLOR

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							
Basic Color	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Red(255)	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Green(255)	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L
	Blue(255)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
	Cyan	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	Magenta	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H
	Yellow	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L
	White	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Red	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Red(1)	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Red(2)	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(253)	H	H	H	H	H	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Red(254)	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Red(255)	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Green	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Green(1)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L
	Green(2)	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(253)	L	L	L	L	L	L	L	L	H	H	H	H	H	H	L	H	L	L	L	L	L	L	L	L
	Green(254)	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L	L
	Green(255)	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	L	L	L	L	L	L	L	L
Blue	Black	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	Blue(1)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H
	Blue(2)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	L	H
	Blue(254)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	L
	Blue(255)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H

Note 1: Color (n) --- 'n' indicates gray scale step.

9. OUTLINE DIMENSIONS

9.1 FRONT VIEW



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

9.2 REAR VIEW

