KOE

JDI Group

Kaohsiung Opto-Electronics Inc.

FOR MESSRS :_____ DATE : Sep. 3rd 2019

CUSTOMER'S ACCEPTANCE SPECIFICATIONS

TX16D204VM0BVA

Contents

ACCEPTED BY:_____ PROPOSED BY: John Chou

2. RECORD OF REVISION

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3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 6.3” WHVGA of 8:3 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, COG (chip on glass) technology and LED backlight are applied on this display.

Part Name	TX16D204VM0BVA
Module Dimensions	167.0(W) mm x 69.0(H) mm x 10.54 (D) mm Max.
LCD Active Area	150.0(W) mm x 52.5(H) mm
Pixel Pitch	0.0625(W) mm x 3 (R.G.B) (W) X0.1875 (H) mm
Resolution	800 x 3(RGB)(W) x 280(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	Light Emitting Diode (LED)
Weight	156g (typ.)
Interface	C-MOS; 18-bit RGB; 50 pins
Power Supply Voltage	3.3V for LCD; 52mA for Backlight (per serial)
Power Consumption	0.35 W for LCD; 1.404 W for Backlight
Viewing Direction	Super Wide Version
Touch Panel	Projected Capacitive type; Cover Glass on ITO Film; I^2C I/F

4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Remarks
Supply Voltage	V_{DD}	-0.3	4	V	-
Input Voltage of Logic	V_I	-0.3	V_{DD}+0.3	V	Note 1
Operating Temperature	Top	-30	85	°C	Note 2
Storage Temperature	Tst	-40	90	°C	Note 2
Backlight Input Current	I_{LED}	-	150	mA	-

Note 1: The rating is defined for the signal voltages of the interface such as PCLK, DE, Hsync, Vsync , XRES, DISP, SLP, RL, TB 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	VI	"H" level	$0.7V_{DD}$	-	V_{DD}	V	Note 1
		"L" level	0	-	$0.3V_{DD}$		
Power Supply Current	I_{DD}	V_{DD}=3.3V	-	-	105	mA	Image: All pixels White Note 2
			-	-	0.5	mA	Sleep mode Note 3
Frame Frequency	f_{Frame}	-	-	60	-	Hz	-
CLK Frequency	f_{CLK}	-	18	20	23	MHz	-

Note 1: Rated values indicate operating range of electrical functions.

Note 2: In-rush current is excluded.

Note 3: At the condition of RGB interface signals, TB and RL are fixed to "H" or "L", backlight is turned off.

5.2 BACKLIGHT CHARACTERISTICS

$T_a = 25\ ^\circ C$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
LED Input Voltage	V_{LED}	I_{LED}=52mA	8.1	-	9.0	V	Note1
LED Forward Current (per serial)	I_{LED}	-	-	52	-	mA	
LED Lifetime	-	I_{LED}=52mA	-	50K	-	hrs	Note2

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

Note 2: The estimated lifetime is specified as the time to reduce 50% brightness by applying 52mA / per serial at 25℃.

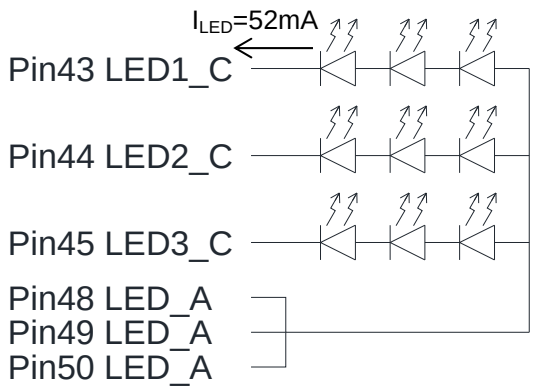


Fig. 5.1

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 15 minutes.
- The ambient temperature is 25℃.
- In the dark room around 100~400 lx, the equipment has been set for the measurements as shown in Fig 6.1.

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Brightness of White		-	$\phi = 0^{\circ}, \theta = 0^{\circ}$, I_{LED}= 52 mA	360	450	-	cd/m^2	Note 1
Brightness Uniformity		-		70	-	-	%	Note 2
Contrast Ratio		CR		500	1000	-	-	Note 3
Response Time (Rising + Falling)		$T_r + T_f$	$\phi = 0^{\circ}, \theta = 0^{\circ}$	-	40	-	ms	Note 4
NTSC Ratio		-	$\phi = 0^{\circ}, \theta = 0^{\circ}$	-	49	-	%	-
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	$\phi = 0^{\circ}, \theta = 0^{\circ}$	0.54	0.59	0.64	-	Note 6
		Y		0.28	0.33	0.38		
	Green	X		0.27	0.32	0.37		
		Y		0.54	0.59	0.64		
	Blue	X		0.10	0.15	0.20		
		Y		0.09	0.14	0.19		
	White	X		0.26	0.31	0.36		
		Y		0.29	0.34	0.39		

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 or equivalent as shown in Fig. 6.2.

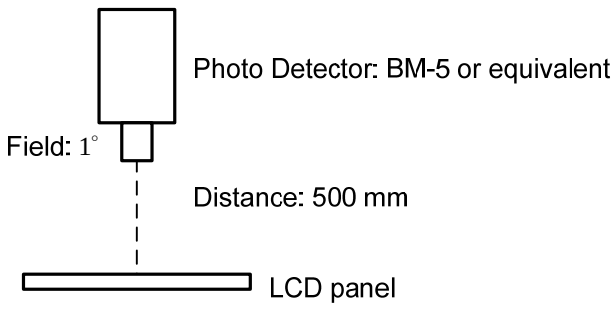


Fig. 6.1

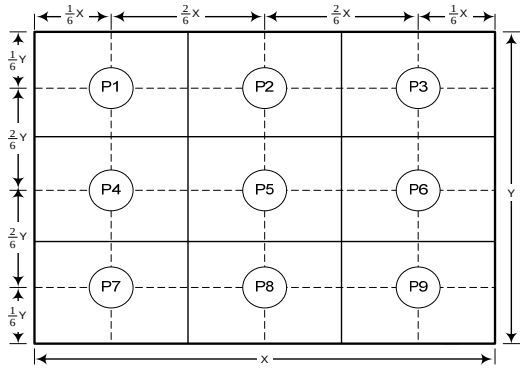


Fig. 6.2

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.

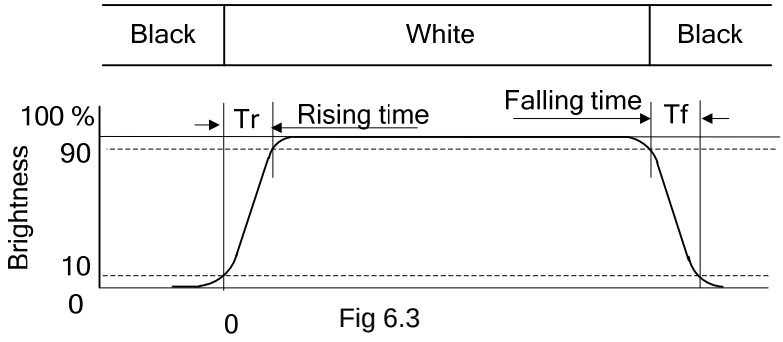


Fig 6.3

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.

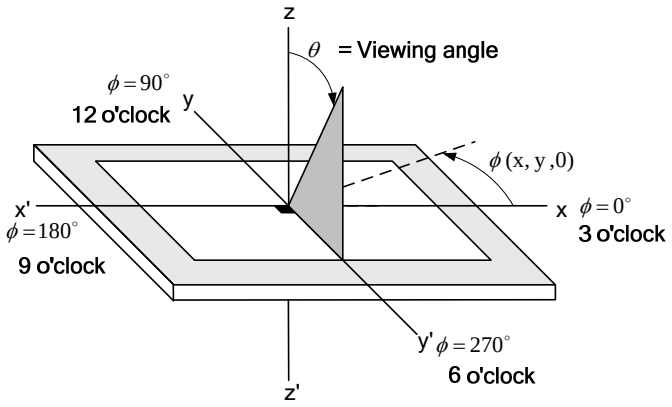
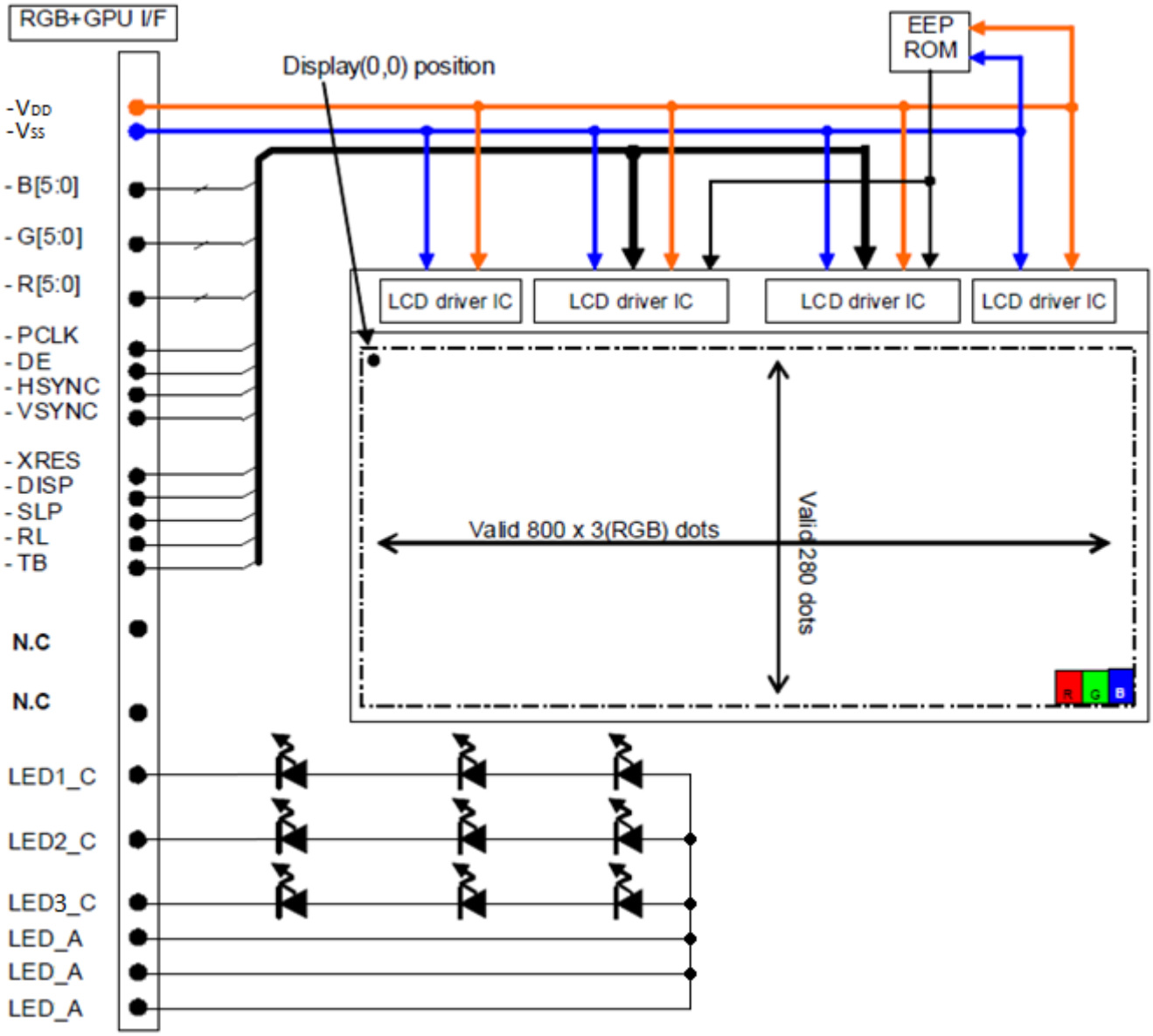


Fig 6.4

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

7. BLOCK DIAGRAM



Note1: Signals are PCLK, DE, Hsync, Vsync, XRES, DISP, SLP, RL, TB and RGB data bus.

8. RELIABILITY TESTS

Test Item	Condition	
High Temperature	1) Operating 2) 85°C	500 hrs
Low Temperature	1) Operating 2) -30°C	500 hrs
High Temperature	1) Storage 2) 90°C	500 hrs
Low Temperature	1) Storage 2) -40°C	500 hrs
Heat Cycle	1) Operating 2) –40°C ~85°C 3) 3hrs~1hr~3hrs	500 hrs
Thermal Shock	1) Non-Operating 2) -40°C↔85°C 3) 0.5 hr↔0.5 hr	500 hrs
High Temperature & Humidity	1) Operating 2) 60°C& 90%RH 3) Without condensation	500 hrs (Note 3)
Vibration	1) Non-Operating 2) 10～200 Hz 3) 5G 4) ±X, ±Y and ±Z directions	1 hrs for each direction
Mechanical Shock	1) Non-Operating 2) 10 ms 3) 80G 4) ±X, ±Y and ±Z directions	Once for each direction
ESD	1) Operating 2) Tip: 150 pF, 330Ω 3) Air discharge for glass: ± 12KV 4) Contact discharge for metal frame: ± 15KV	1) Glass: 9 points 2) Metal frame: 8 points (Note 4)

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

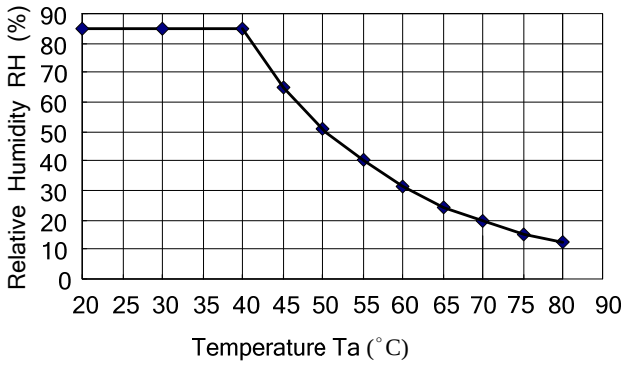


Fig. 8.1

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

9. LCD INTERFACE

9.1 INTERFACE PIN CONNECTIONS

Pin assignment is as below:

Pin No.	Signal	I/O	Function
1	V_{DD}	P	Power Supply
2	V_{DD}	P	Power Supply
3	V_{SS}	P	Ground
4	V_{SS}	P	Ground
5	B5	I	Blue Data (MSB)
6	B4	I	Blue Data
7	B3	I	
8	B2	I	
9	B1	I	
10	B0	I	Blue Data (LSB)
11	V_{SS}	P	Ground
12	G5	I	Green Data (MSB)
13	G4	I	Green Data
14	G3	I	
15	G2	I	
16	G1	I	
17	G0	I	Green Data (LSB)
18	V_{SS}	P	Ground
19	R5	I	Red Data (MSB)
20	R4	I	Red Data
21	R3	I	
22	R2	I	
23	R1	I	
24	R0	I	Red Data (LSB)
25	V_{SS}	P	Ground
26	V_{SS}	P	Ground
27	PCLK	I	Pixel clock signal.
28	V_{SS}	P	Ground
29	V_{SS}	P	Ground
30	DE	I	Data Enable
31	HSYNC	I	Horizontal synchronous signal. This signal is active “L”.
32	VSYNC	I	Vertical synchronous signal. This signal is active “L”.

Pin No.	Signal	I/O	Function
33	V_{SS}	P	Ground
34	XRES	I	Display is initialized when XRES is set to “L”.
35	V_{SS}	P	Ground
36	DISP	I	Display on and off control. “H” Display on. “L” Display off.
37	SLP	I	Booster on and off control. “H” LCD internal power on. “L” LCD internal power off. Please do not change input level for this terminal while operating.
38	RL	I	Horizontal scanning direction selection pin. “H” Left to Right. “L” Right to Left.
39	TB	I	Vertical scanning direction selection pin “H” TOP to Bottom. “L” Bottom to Top.
40	NC	-	No Connection
41	NC	-	No Connection
42	V_{SS}	P	Ground
43	LED1_C	P	LED cathode 1
44	LED2_C	P	LED cathode 2
45	LED3_C	P	LED cathode 3
46	NC	-	No Connection
47	NC	-	No Connection
48	LED_A	P	LED anode
49	LED_A	P	LED anode
50	LED_A	P	LED anode

The capacitive touch panel interface FPC : Pitch 0.5mm 10pins

Pin assignment is as below :

Pin No.	Signal	Function
1	V_{SS}	Ground
2	SDA	I^2C Serial Data
3	SCL	I^2C Serial Clock
4	NC	No Connection
5	INT	Inform Host to Get Finger Information
6	RST	Global Reset Input
7	Vcc	Power Supply for T/P (5V)
8	NC	No Connection
9	NC	No Connection
10	NC	No Connection

9.2 TIMING CHART

A. RGB interface timing

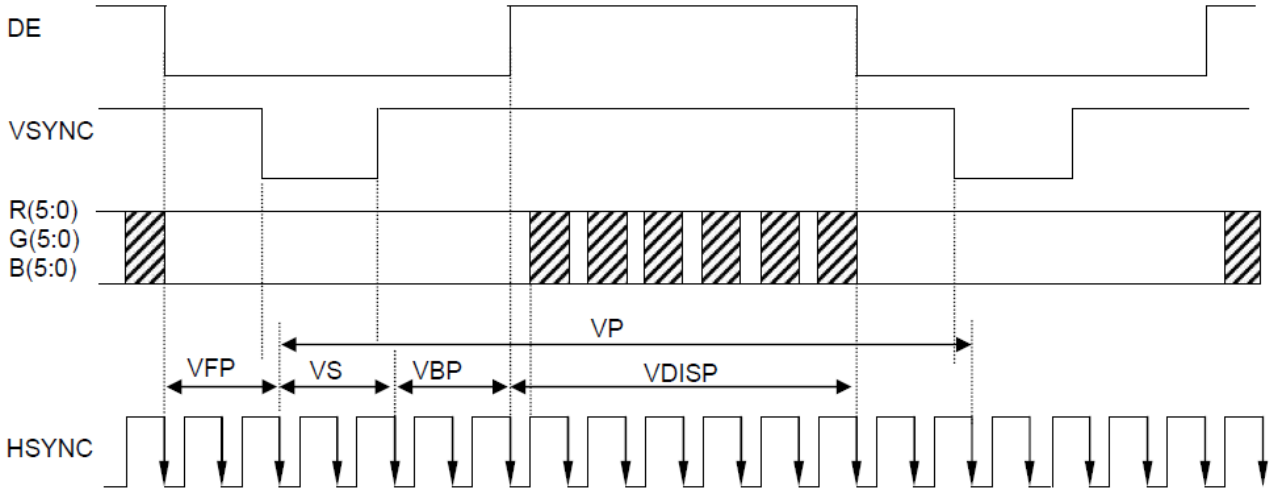


Fig. 9.1 Vertical Timing

Signal	Parameter	MIN	TYP	MAX	Unit	Description
VP	Vertical cycle	315	315	315	Line	*1, *2, *3
VS	Vertical “L” pulse width	12	12	12	Line	
VBP	Vertical back porch	16	16	16	Line	
VFP	Vertical front porch	7	7	7	Line	
VDISP	Vertical active area	280	280	280	Line	
VRR	Frame rate		60		Hz	*4

*1 The rise and fall times of all input signals (tr, tf) are equal or less than 8ns.
*2 For timing of input signals, they are set using 30 % and 70 % of V_{DD} as the base reference.
*3 Number of line is counted an inputted HSYNC falling edge after VSYNC signal is changed.
*4 LCD frame rate should be adjusted 60Hz by porch clock numbers. See 4.2.1 (2).
*5 There is no tolerance for VP,VS,VBP,VFP,VDISP. Please use fixed value.

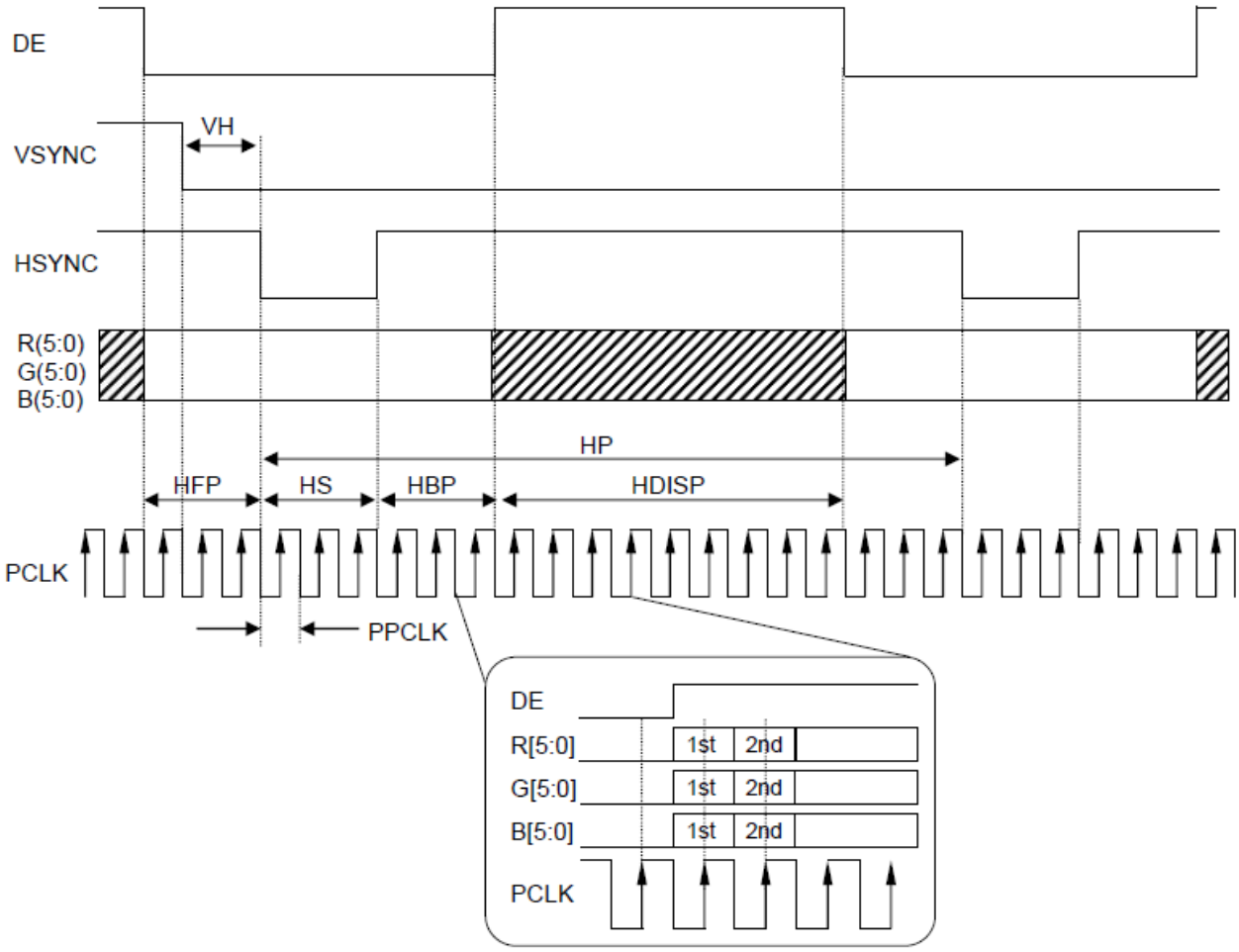


Fig. 9.2 Horizontal Timing

Signal	Parameter	MIN	TYP	MAX	Unit	Description
VH	Phase difference of VSYNC-HSYNC	0	-	898	PCLK	*3
HP	Horizontal cycle	960	1056	1224	PCLK	*1, *2
HS	Horizontal “L” pulse width	80	128	128	PCLK	
HBP	Horizontal back porch	56	88	256	PCLK	
HFP	Horizontal front porch	24	40	40	PCLK	
HDISP	Horizontal active area	800	800	800	PCLK	
f_{PCLK}	Pixel clock frequency	18	20	23	MHz	
PPCLK		43.47	50	55	ns	

*1 The rise and fall times of all input signals (tr, tf) are equal or less than 8ns.
*2 For timing of input signals, they are set using 30 % and 70 % of V_{DD} as the base reference.
*3 VH Max value is HP(Horizontal cycle)-62.

B. CLOCK AND DATA INPUT TIMING

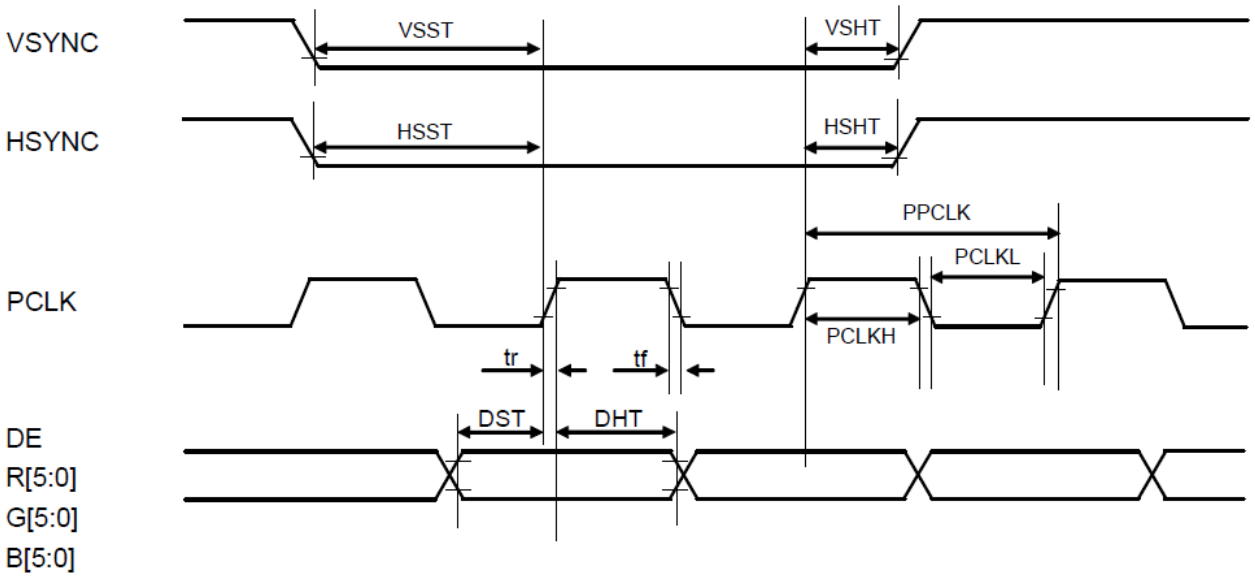


Fig. 9.3 Setup & Hold Time of Data, DE signal, Hsync and Vsync signal.

Signal	Symbol	Parameter	MIN	TYP	MAX	Unit	Description
VSYNC	VSST	VSYNC set up time	10	-	-	ns	
	VSHT	VSYNC hold time	10	-	-	ns	
HSYNC	HSST	HSYNC set up time	10	-	-	ns	
	HSHT	HSYNC hold time	10	-	-	ns	
PCLK	PPCLK	Pixel clock period	43.47	-	-	ns	
	PCLKL	Pixel clock low time	14	-	-	ns	*1, *2
	PCLKH	Pixel clock high time	14	-	-	ns	
DE R[5:0] G[5:0] B[5:0]	DST	Data setup time	10	-	-	ns	
	DHT	Data hold time	10	-	-	ns	

*1 The rise and fall times of all input signals (tr, tf) are equal or less than 8ns.
*2 For timing of all input signals, they are set using 30 % and 70 % of V_{DD} as the base reference.

C. RESET TIMING

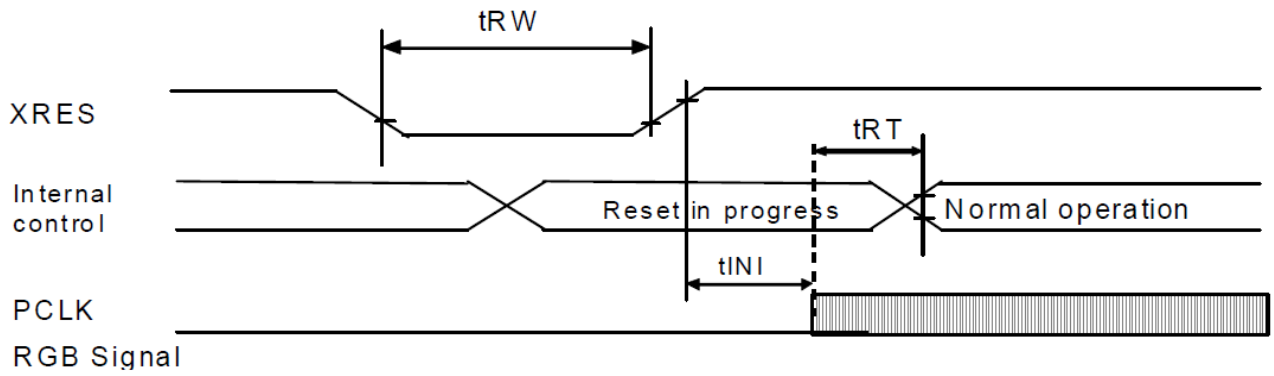


Fig. 9.4 Reset timing

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
XRES	tRW	reset pulse width	20	-	us	*1
	tINI	initial start	1	-	ms	*2, *3
	tRT	Clear reset	-	10	ms	*1, *2

*1 The rise and fall times of the input signal (tr, tf) are equal or less than 15ns.
For all timings are set using 30 % and 70 % of V_{DD}-V_{SS} as the base reference.
*2 It must be avoid to transfer the GPU IF terminals for this period.
*3 It is necessary to avoid input PCLK and RGB signals at this period.

9.3 RECOMMENDED SEQUENCE

Power ON

(1) Start to supply system power (V_{DD}).
(2) Make a device reset after starting to supply the system power.
(XRES must be kept "L" for more than 20us to less than 200ms.)
(3) Wait more than 1ms to less than 10ms after releasing the system reset.
(4) Input logic signals (PCLK, HSYNC, VSYNC, DE and RGB data).
(5) Wait more than 10ms after input logic signals.
(6) Transfer “L” to “H” of SLP signal. (Internal power is started.)
(7) TB and RL signals are fixed in the direction of display, if necessary.
(8) Backlight turns on.

Power OFF

(9) Backlight turns off.
(10) Transfer “H” to “L” of SLP signal. (Internal power and display is stopped.)
(11) Wait more than 50 ms, then transfer “H” to “L” of DISP signal.
(12) Wait more than 250 ms, then XRES signal turns “L” state.
(13) Stop to supply system power（V_{DD}）.

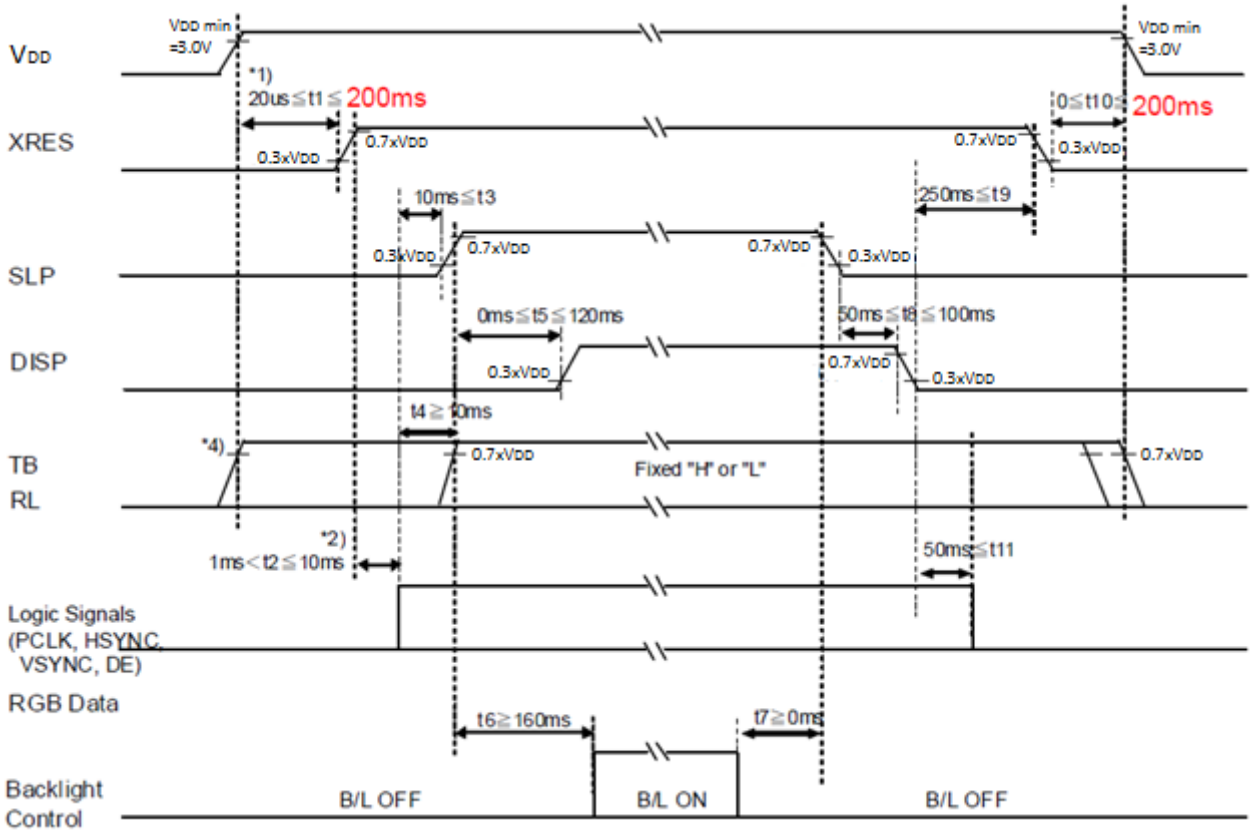


Fig. 9.5 Recommended sequence

Notes)

* 1 XRES must be maintained to “LOW” more than 20us after turning on the system power (V_{DD}).
* 2 Logic signals should be start more than 1 ms after XRES signal is released.
* 3 The rising speed of V_{DD} should be less than 2V/100us.
* 4 TB and RL signals allow fix the V_{DD} or V_{SS}.

9.4 INTERVAL POWER ON AND OFF

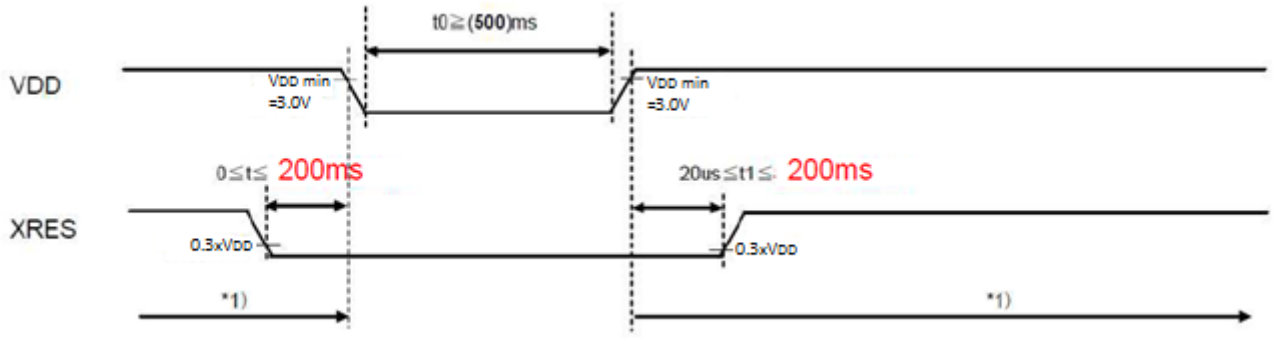


Fig. 9.6 Interval Power on/off Timing

Notes)

* 1 Please refer to 8.3 RECOMMENDED SEQUENCE when system power(V_{DD}) is stopped and when after system power(V_{DD}) is running.

9.5 TRANSITION OF POWER MODE

This module has three power modes as following.

a) SLEEP MODE : Internal power OFF, LCD driving is OFF in this mode.

b) DISPLAY ON MODE : Internal power ON, LCD driving is ON in this mode.

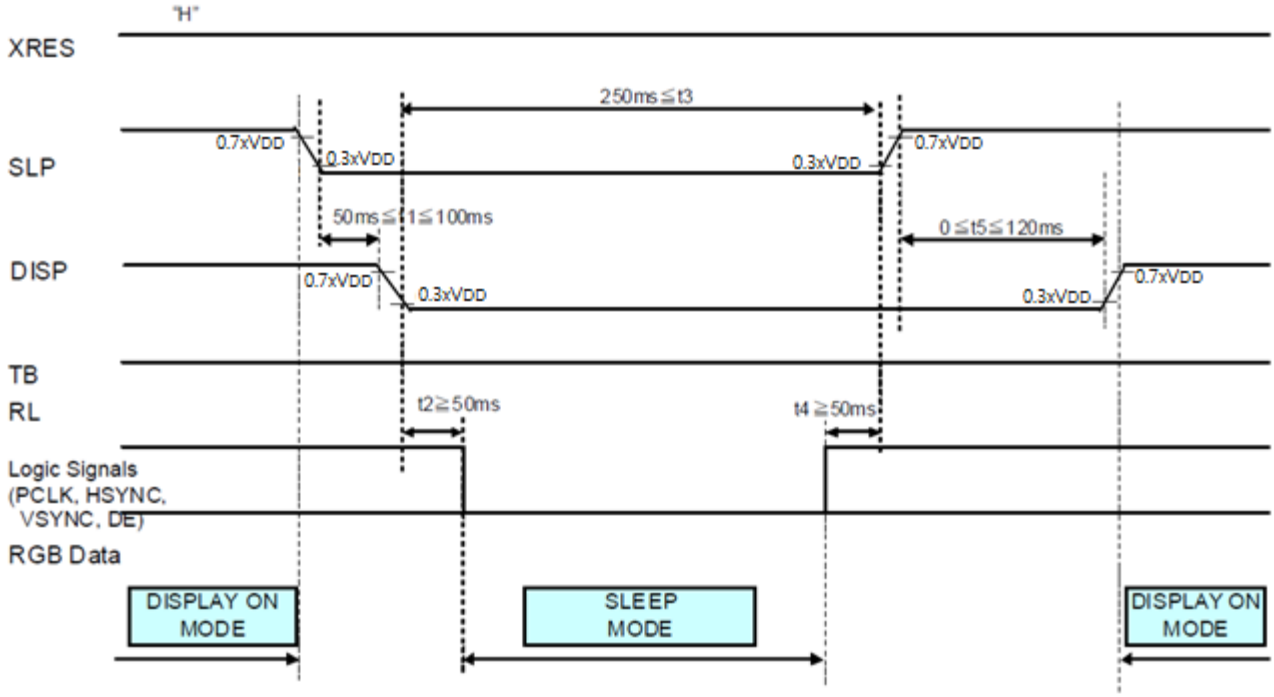


Fig. 9.7 Power Transition Timing

9.6 GPU INTERFACE

Display control is possible by using the following 4 terminals: DISP, SLP, TB and RL.

Terminal	Description
DISP	Display on and off control. H : display on. L : display off.
SLP	Booster on and off control. H : LCD internal power on. L : LCD internal power off.
TB	Vertical scanning direction selection pin. H : Top to bottom L : Bottom to top
RL	Horizontal scanning direction selection pin. H : Left to right L : Right to left.

See 9.3 RECOMMENDED SEQUENCE to design a sequence and intervals.

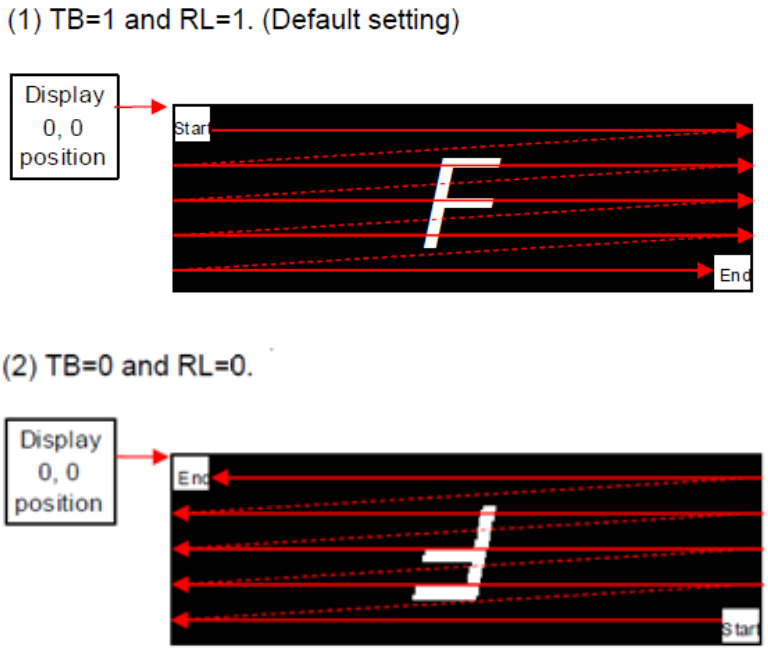
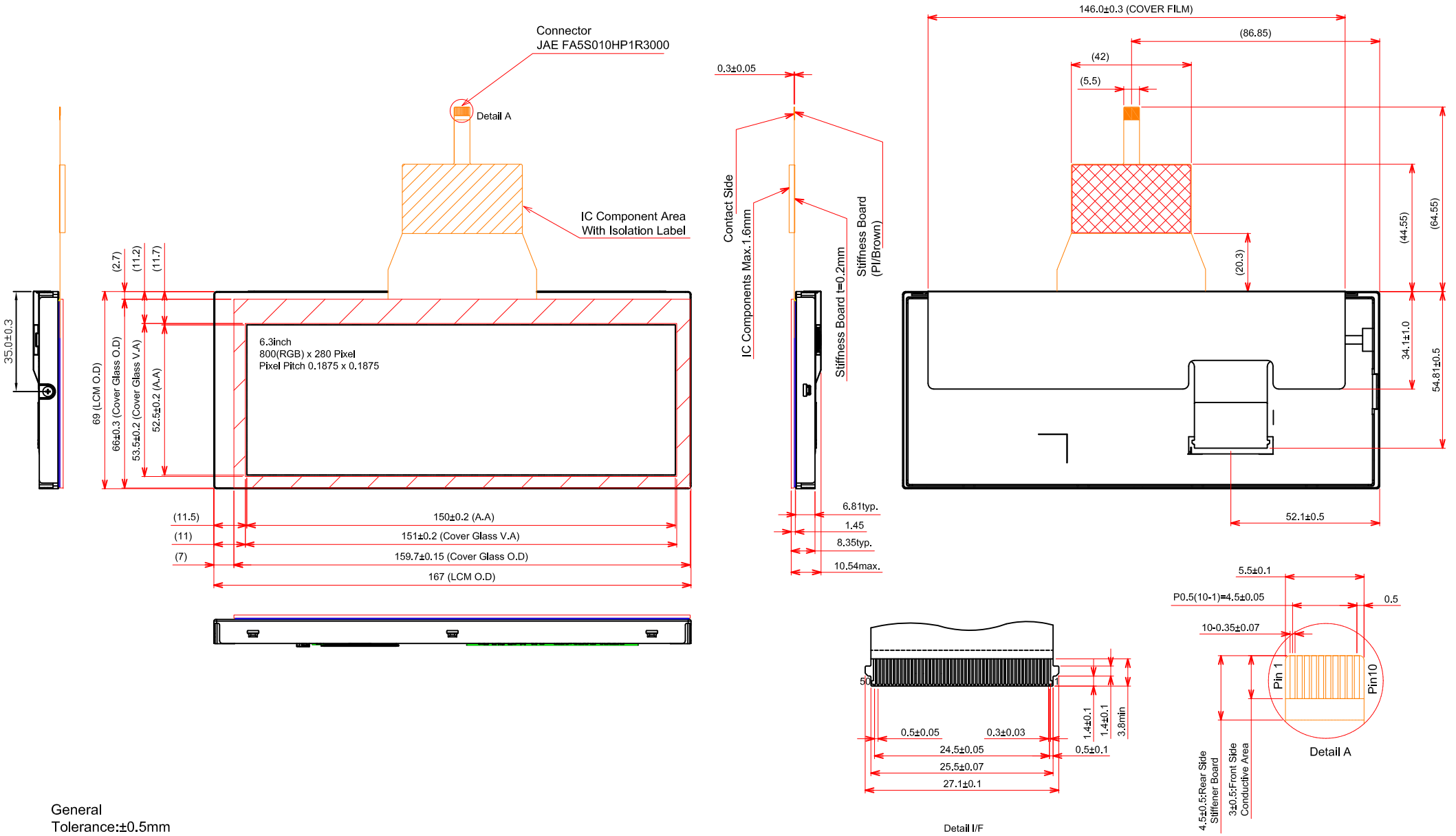


Fig. 9.8 Scanning direction selection

9.7 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 (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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red (61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green (61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	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

10. OUTLINE DIMENSIONS



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

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11. TOUCH PANEL

The type of touch panel used on this display is capacitive touch panel film, and more characteristics are shown as below:

11.1 MECHANICAL CHARACTERISTICS

Item	Specification	Remarks
Thickness	1.45 ± 0.2 mm	Chemically Strengthened Glass
CG Material	Soda lime	-
Surface Hardness	≧6H	-
Touch Function	2 points	-

11.2 ELECTRICAL CHARACTERISTICS

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

Item	Symbol	Symbol	Value			Unit	Remarks
			Min.	Typ.	Max.		
Power supply voltage	V_{CC}	V_{CC}-V_{SS}	-	5.0	-	V	-

11.3 CONTROLLER CHARACTERISTICS

The capacitive touch panel features as below:

- Controller IC is EETI-EXC3132
- Support I^2C interface.
- Firmware information:

  Mode Name: SIRIUS_7012

  Type Name: PCAP3132I SERIES

  Version: 00_T1

12. APPEARANCE STANDARD

The appearance inspection is performed in a dark room around 500~1000 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 θ shown in Fig. 12.1 The inspection should be performed within 45° when display is shut down. The inspection should be performed within 5° when display is power on.

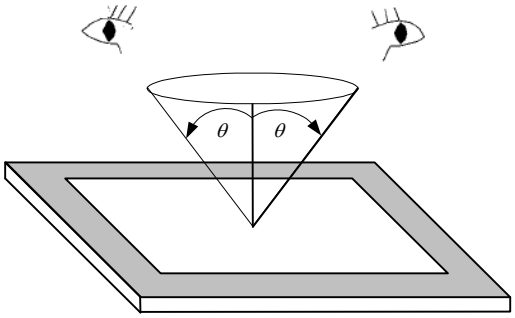


Fig. 12.1

12.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 3 areas as shown in Fig.12.2 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.

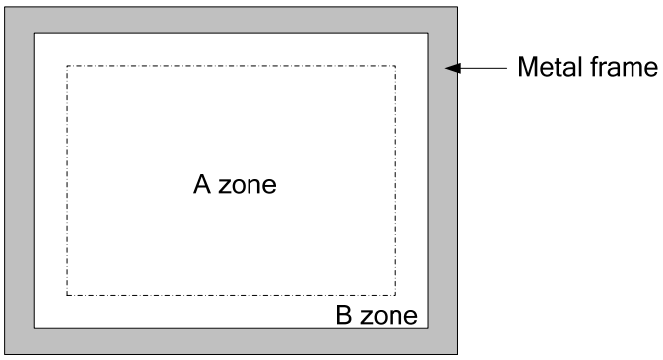


Fig. 12.2

12.2 LCD APPEARANCE SPECIFICATION

The specification as below is defined as the amount of unexpected phenomenon or material in different zones of LCD panel. The definitions of length, width and average diameter using in the table are shown in Fig. 12.3 and Fig. 12.4.

Item	Criteria			Applied zone
Dent	Serious one is not allowed			A
Wrinkles in polarizer	Serious one is not allowed			A
Bubbles on polarizer	Average diameter (mm)	Maximum number		A
		A zone	B zone	
	D ≦0.3	Ignored	Ignored	
	0.3< D ≦0.4	3	Ignored	
	0.4< D ≦0.6	2	3	
	0.6< D	Not allowed	Not allowed	
1) Stains 2) Foreign Materials 3) Dark Spot	Filamentous (Line shape)			A, B
	Length (mm)	Width (mm)	Maximum number	
	L ≦0.3	W ≦0.15	Ignored	
	0.3< L ≦2.0	0.03< W ≦0.15	3	
	2.0< L	0.03< W	Not allowed	
	Round (Dot shape)			A, B
	Average diameter (mm)	Maximum number		
		A zone	B zone	
	D ≦0.15	Ignored	Ignored	
	0.15< D ≦0.2	3	4	
	0.2< D ≦0.25	2	3	
	0.25< D ≦0.3	Not allowed	1	
	0.3< D	Not allowed	Not allowed	
	Those wiped out easily are acceptable Distance between defects : ≧10mm			
Dot-Defect (Note 1)		Type	Maximum number	A
	Bright dot-defect	1 dot	Not allowed	
		2 adjacent dot	Not allowed	
		3 adjacent dot or above	Not allowed	
		In total	Not allowed	
	Dark dot-defect	1 dot	3	
		2 adjacent dot	Not allowed	
		3 adjacent dot or above	Not allowed	
		In total	3	
	In total		3	

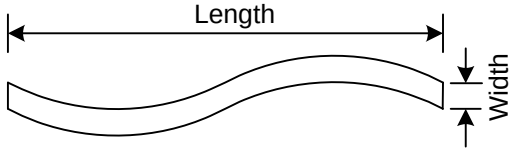
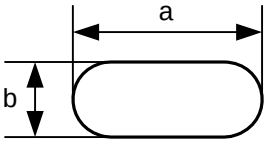


Fig. 12.3



Average diameter = $\frac{a+b}{2}$

Fig. 12.4

Note 1: The definitions of dot defect are as below:

- The defect area of the dot must be bigger than half of a dot.
- For bright dot-defect, showing black pattern, the dot's brightness must be over 30% brighter than others.
- For dark dot-defect, showing white pattern, the dot's brightness must be under 70% darker than others.
- The definition of 1-dot-defect is the defect-dot, which is isolated and no adjacent defect-dot.
- The definition of adjacent dot is shown as Fig. 12.5.

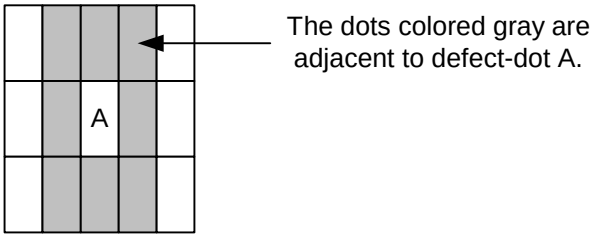


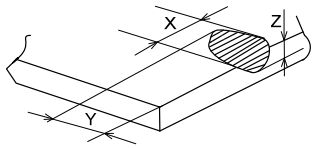
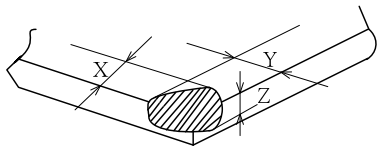
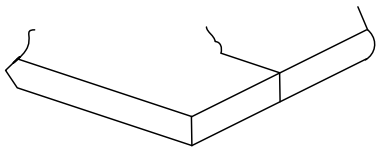
Fig. 12.5

12.3 TOUCH PANEL APPEARANCE SPECIFICATION

The specification as below is defined by the amount of unexpected material in different zones of touch panel.

Item	Criteria			Applied zone
Scratches	Width (mm)	Length (mm)	Maximum number	A
	0.07＜W	10＜L	Not allowed	
	0.03＜W≦0.07	L≦10	3	
	W≦0.03	L≦10	Ignored	
Foreign Materials	Filamentous (Line shape)			A
	Width (mm)	Length (mm)	Maximum number	
	0.07＜W	10＜L	Not allowed	
	0.03＜W≦0.07	L≦10	3	
	W≦0.03	L≦10	Ignored	
	Round (Dot shape)			A
	Average diameter (mm)		Maximum number	
	0.5＜D		Not allowed	
	0.2＜D≦0.5		3	
	D≦0.2		Ignored	

The limitation of glass flaw occurred on touch panel is defined in the table as below.

Item	Specifications	
Edge flaw		X ≤ 0.3 mm Y ≤ 0.2 mm Z ≤ 0.5 x Thickness
Corner flaw		X ≤ 0.2 mm Y ≤ 0.2 mm Z ≤ 0.5 x Thickness
Progressive flaw		Not allowed

13. PRECAUTIONS

13.1 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.

2) Please remove the protection film very slowly before turning on the display to avoid generating ESD.

13.2 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.

3) 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.

4) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean display's surfaces.

5) 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.

6) Please wipe any unknown liquids immediately such as saliva, water or dew on the display to avoid color fading or any permanently damages.

7) Maximum pressure to the surface of the display must be less than 1.96×10^4 Pa. If the area of adding pressure is less than $1\,cm^2$, the maximum pressure must be less than 1.96N.

13.3 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 $25\,C^\circ$. 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 ± 100 mV.

13.4 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℃~35℃ 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 KOE, and do not unpack it.
4) Please do not stick any labels on the display surface for a long time, especially on the polarizer.

14. DESIGNATION of LOT MARK

1) The lot mark is showing in Fig.14.1. First 4 digits are used to represent production lot, T represented made in Taiwan, and the last 6 digits are the serial number.

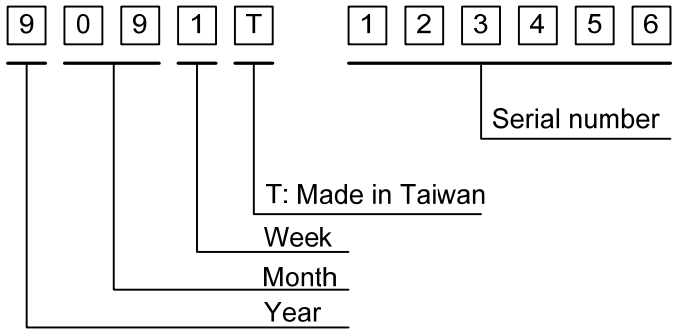


Fig. 14.1

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

Year	Lot Mark
2019	9
2020	0
2021	1
2022	2
2023	3

Month	Lot Mark	Month	Lot Mark
Jan.	01	Jul.	07
Feb.	02	Aug.	08
Mar.	03	Sep.	09
Apr.	04	Oct.	10
May	05	Nov.	11
Jun.	06	Dec.	12

Week	Lot Mark
1~7 days	1
8~14 days	2
15~21 days	3
22~28 days	4
29~31 days	5

3) The location of the lot mark is on the back of the display shown in Fig. 14.2

Label example :

Fig. 14.2