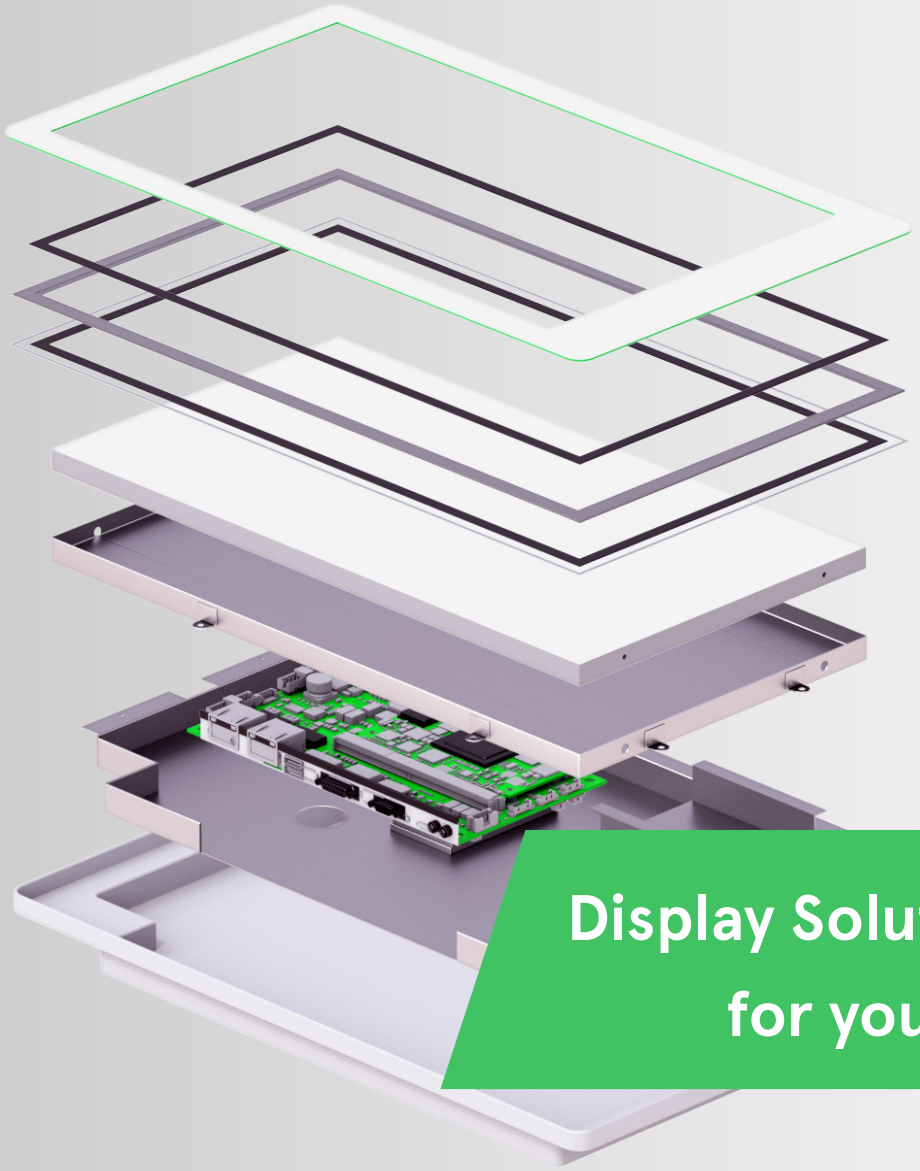
AVNET EMBEDDED



Display Solutions tailored for your Application

DATASHEET

TX26D206VM0BAA

KOE

JDI Group

Kaohsiung Opto-Electronics Inc.

FOR MESSRS : _____ DATE : Jan. 25th ,2019

CUSTOMER'S ACCEPTANCE SPECIFICATIONS

TX26D206VM0BAA

Contents

ACCEPTED BY : _____ PROPOSED BY : Oblack Tsai

2. RECORD OF REVISION

DATE	SHEET No.	SUMMARY

3. GENERAL DATA

3.1 DISPLAY FEATURES

This module is a 10.25” HD of 8:3 format LTPS 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	TX26D206VM0BAA
Module Dimensions	259.0(W) mm x 111.4(H) mm x 14.2 (D) mm
LCD Active Area	243.7(W) mm x 91.4(H) mm
Pixel Pitch	0.1269(W) mm x 0.1269 (H) mm
Resolution	1920 x 3(RGB)(W) x 720(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	430g
Interface	2ch-LVDS; 50 pins
Power Supply Voltage	3.3V for LCD; 12V for Backlight
Power Consumption	0.46W for LCD , 8.2W for Backlight
Viewing Direction	Super Wide Version (In-Plane Switching)

4. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Remarks
Supply Voltage	V_{DD}	-0.3	4.0	V	-
Input Voltage of Logic	V_I	-0.3	V_{DD} +0.3	V	Note 1
Operating Temperature	T_{op}	-40	85	˚C	Note 2
Storage Temperature	T_{st}	-40	90	˚C	Note 2
Backlight Input Voltage	V_{LED}	6	21	V	-
Backlight Voltage for PWM	V_{PWM}	-0.3	6	V	-
Backlight Voltage for VDC	V_{DC}	0	4.0	V	-
Backlight Voltage for EN	V_{EN}	-0.3	6	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

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

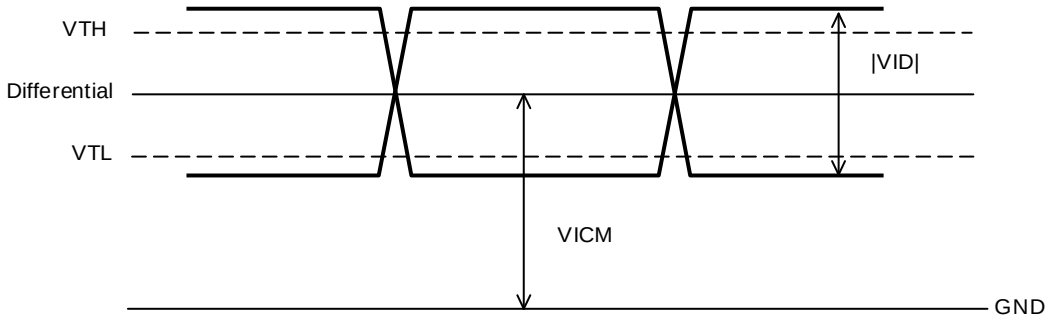
Item	Symbol	Condition	Standard Value			Unit	Remarks
			Min.	Typ.	Max.		
Power Supply Voltage	V_{DD}	-	3.0	3.3	3.6	V	-
Power Supply Current	I_{DD}	Note 1	-	138	210	mA	Note 1,4
Input Signal Voltage (CMOS)	V_{IH1}	-	$0.8V_{DD}$	-	V_{DD}	V	Note 2
	V_{IL1}	-	V_{SS}	-	$0.2V_{DD}$	V	
Allowable Ripple Voltage	VRP	-	-	-	100	mV (p-p)	-
Differential Input High Threshold	VTH	VICM=1.2V	-	-	100	mV	Note 3
Differential Input Low Threshold	VTL	VICM=1.2V	-100	-	-	mV	
Input Differential Voltage	|VID|	-	100	-	600	mV	
Differential Input Common Mode Voltage	VICM	-	1.125	1.2	1.375	V	

Note 1: Measurement pattern: All white.

Power supply voltage: Typ. voltage.

Note 2: Signals of interest is UL / DR.

Note 3: Signal of interest is LVDS.



Note 4: 0.63A fuse is applied in the module for I_{DD}. For display activation and protection purpose, power supply is recommended larger than 1.6A 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}	I_{LED}=680mA	11.5	12	12.5	V	Note 1
LED Forward Current	I_{LED}	3.3V_{DC}; 100% duty	610	680	750	mA	Note 2
		0.2 V_{DC}; 0% duty	18	20	22		
PWM Signal Voltage	-	High	2.5	3.3	5	V	-
		Low	-	-	0.9		
		Range	0	-	100	%	
EN Voltage	V_{EN}	-	2.5	3.3	5.0	V	-
LED Lifetime	-	I_{LED}=680mA	-	50K	-	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 1K ~ 10KHz with 3.3 V amplitude.

Note 3: The estimated lifetime is specified as the time to reduce 50% brightness by applying 680mA at 25°C.

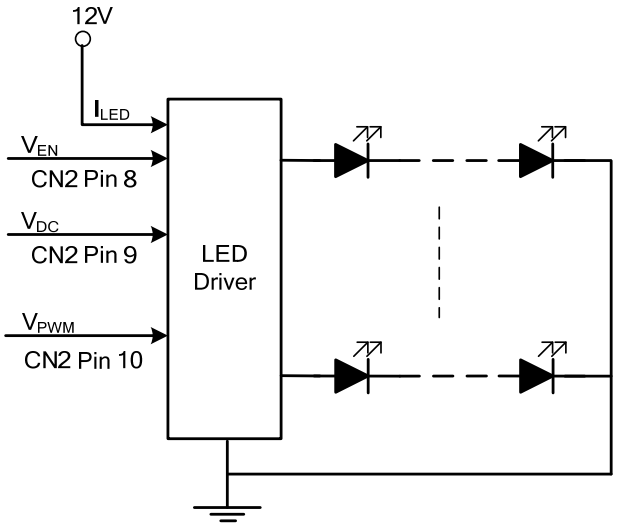


Fig 5.1

Note 4: By applying different I_{LED}, the estimated brightness and LED life time curves are shown as Fig 5.2 and Fig 5.3 for various environment use.

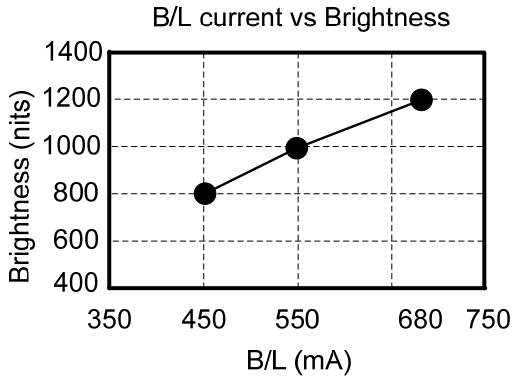


Fig 5.2 LED Current v.s. Brightness

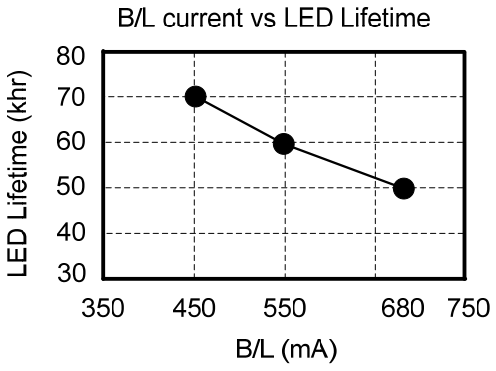


Fig 5.3 LED Current v.s. Lifetime

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.

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

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remarks
Brightness of White		-	$\phi = 0^\circ, \theta = 0^\circ$, I_{LED}= 680 mA	950	1200	-	cd/m^2	Note 1
Brightness Uniformity		-		70	-	-	%	Note 2
Contrast Ratio		CR		500	1000	-	-	Note 3
Response Time		$T_r + T_f$	$\phi = 0^\circ, \theta = 0^\circ$	-	20	-	ms	Note 4
NTSC Ratio		-	$\phi = 0^\circ, \theta = 0^\circ$	-	70	-	%	-
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	$\phi = 0^\circ, \theta = 0^\circ$	0.59	0.64	0.69	-	Note 6
		Y		0.26	0.31	0.36		
	Green	X		0.28	0.33	0.38		
		Y		0.58	0.63	0.68		
	Blue	X		0.09	0.14	0.19		
		Y		0.00	0.05	0.10		
	White	X		0.26	0.31	0.36		
		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.

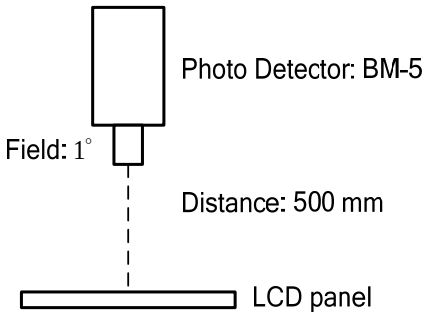


Fig. 6.1

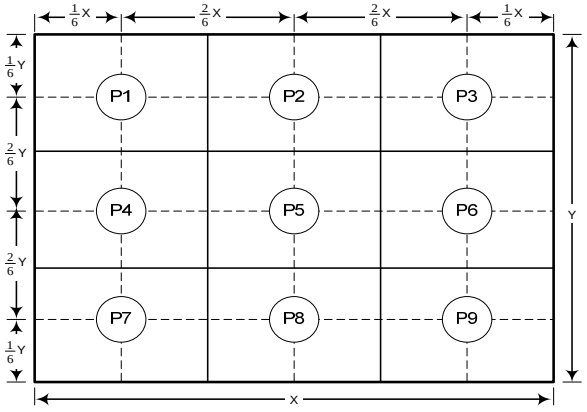


Fig. 6.2

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 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.

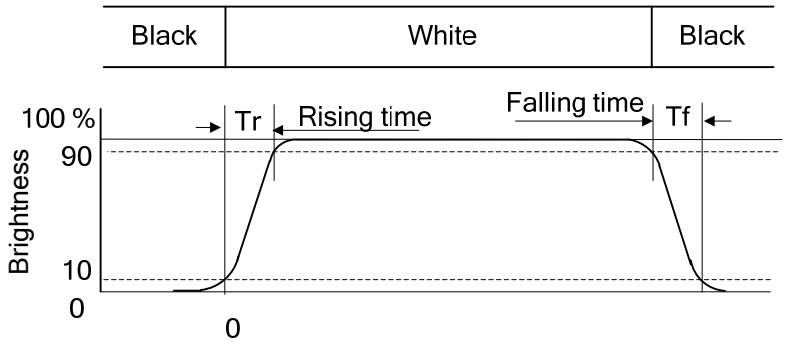


Fig 6.3

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.

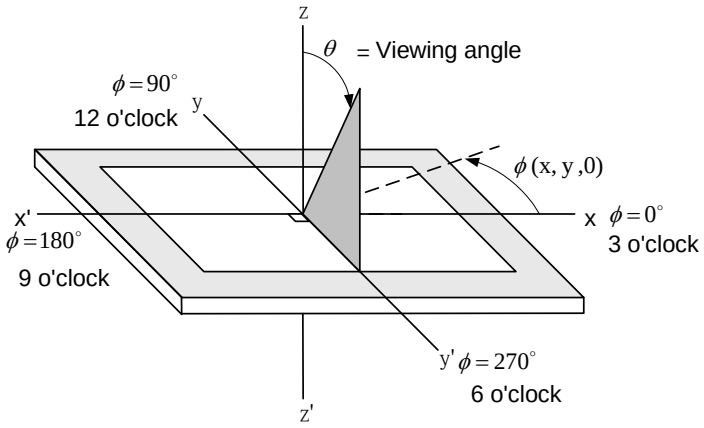
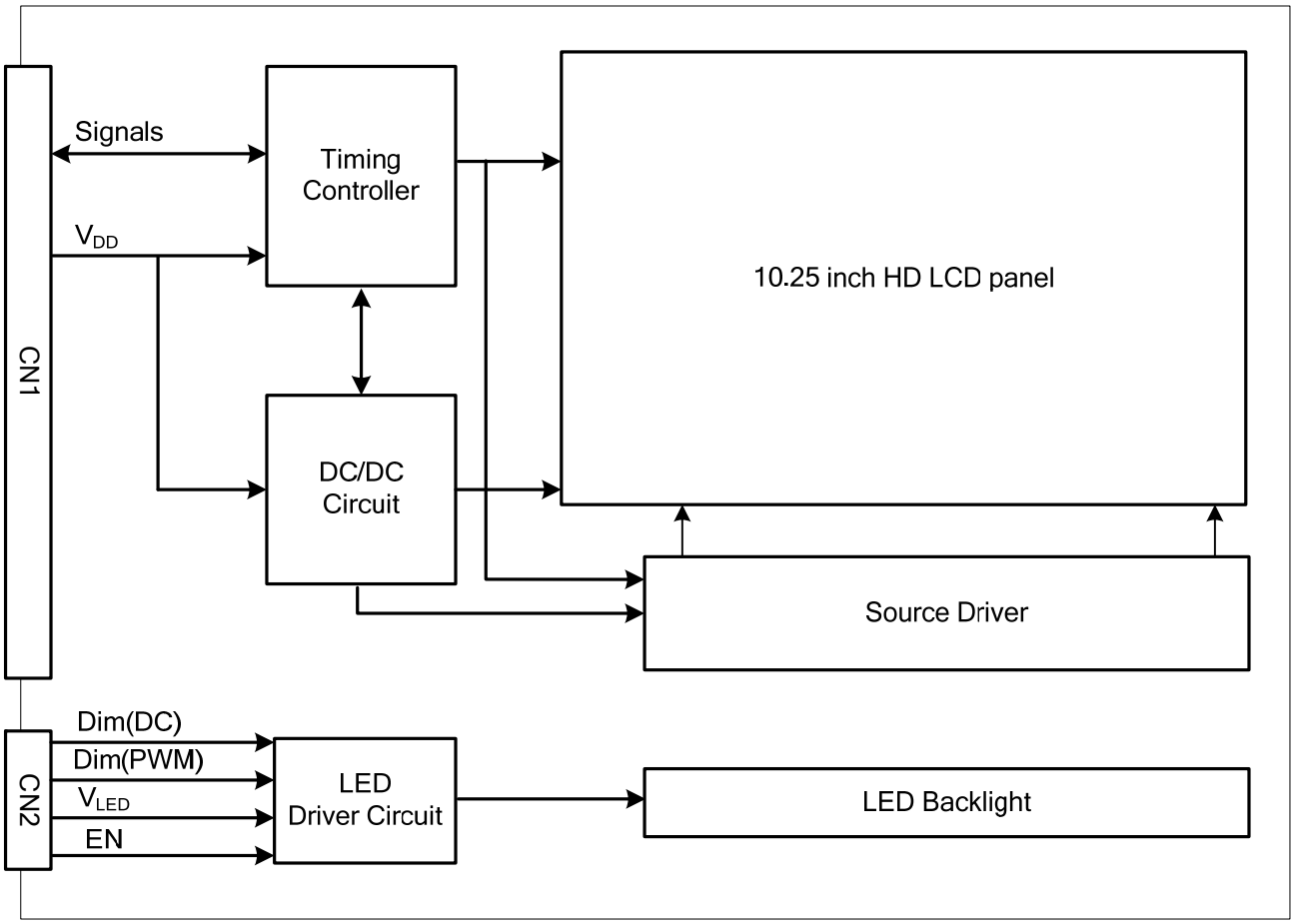


Fig 6.4

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

7. BLOCK DIAGRAM



8. RELIABILITY TESTS

Test Item	Condition	
High Temperature	1) Operating 2) 85°C	500 hrs
Low Temperature	1) Operating 2) -40°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) –30°C ~80°C 3) 3hrs~1hr~3hrs	500 hrs
Thermal Shock	1) Non-Operating 2) -35°C↔85°C 3) 0.5 hr↔0.5 hr	500 hrs
High Temperature & Humidity	1) Operating 2) 65°C& 85%RH 3) Without condensation	500 hrs (Note 4)
Vibration	1) Non-Operating 2) 10~200 Hz 3) 5G 4) X, Y, and Z directions	1 hr 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 3)

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

Note 4: 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.

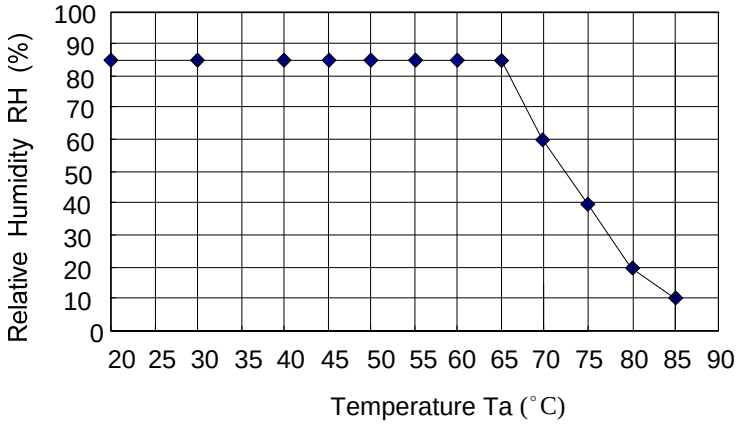


Fig. 8.1

9. LCD INTERFACE

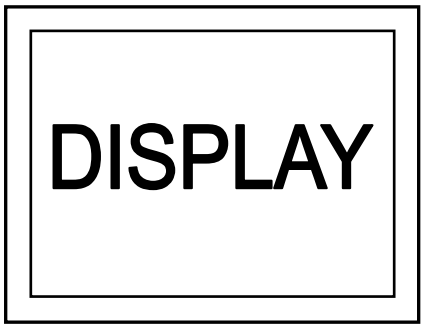
9.1 INTERFACE PIN CONNECTIONS

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

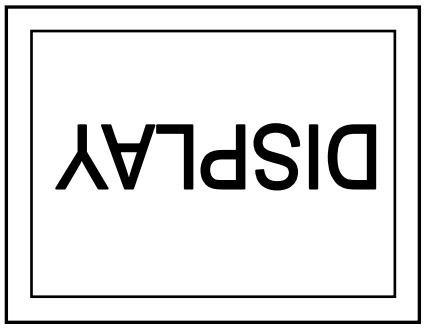
No	Symbol	Function	I/O
1	GND	GND (0V)	I
2	GND	GND (0V)	I
3	GND	GND (0V)	I
4	GND	GND (0V)	I
5	NC	Not connected	-
6	NC	Not connected	-
7	GND	GND (0V)	I
8	GND	GND (0V)	I
9	GND	GND (0V)	I
10	GND	GND (0V)	I
11	NC	Not connected	-
12	VDD	+3.3V	I
13	VDD	+3.3V	I
14	VDD	+3.3V	I
15	VDD	+3.3V	I
16	NC	Not connected	-
17	UL/DR	Up & Left / Down & Right switching terminal (Note1)	I
18	GND	GND (0V)	I
19	NC	Not connected	-
20	GND	GND (0V)	I
21	RO0-	-LVDS differential data input, Chan 0-odd	I
22	RO0+	+LVDS differential data input, Chan 0-odd	I
23	GND	GND (0V)	I
24	RO1-	-LVDS differential data input, Chan 1-odd	I
25	RO1+	+LVDS differential data input, Chan 1-odd	I
26	GND	GND (0V)	I
27	RO2-	-LVDS differential data input, Chan 2-odd	I
28	RO2+	+LVDS differential data input, Chan 2-odd	I
29	GND	GND (0V)	I
30	CLKO-	-LVDS clock input(odd)	I

No	Symbol	Function	I/O
31	CLKO+	+LVDS clock input(odd)	I
32	GND	GND (0V)	I
33	RO3-	-LVDS differential data input, Chan 3-odd	I
34	RO3+	+LVDS differential data input, Chan 3-odd	I
35	GND	GND (0V)	I
36	RE0-	-LVDS differential data input, Chan 0-Even	I
37	RE0+	+LVDS differential data input, Chan 0-Even	I
38	GND	GND (0V)	I
39	RE1-	-LVDS differential data input, Chan 1-Even	I
40	RE1+	+LVDS differential data input, Chan 1-Even	I
41	GND	GND (0V)	I
42	RE2-	-LVDS differential data input, Chan 2-Even	I
43	RE2+	+LVDS differential data input, Chan 2-Even	I
44	GND	GND (0V)	I
45	CLKE-	-LVDS clock input(Even)	I
46	CLKE+	+LVDS clock input(Even)	I
47	GND	GND (0V)	I
48	RE3-	-LVDS differential data input, Chan 3-Even	I
49	RE3+	+LVDS differential data input, Chan 3-Even	I
50	GND	GND (0V)	I

Note 1: The scanning direction in is defined as below.



U/L/DR: Low or Open

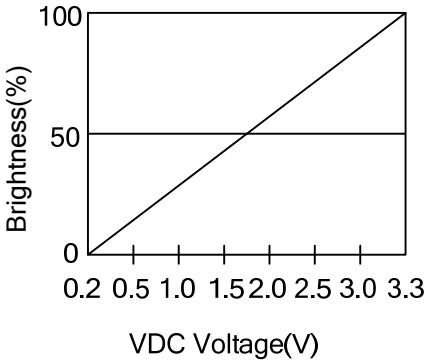


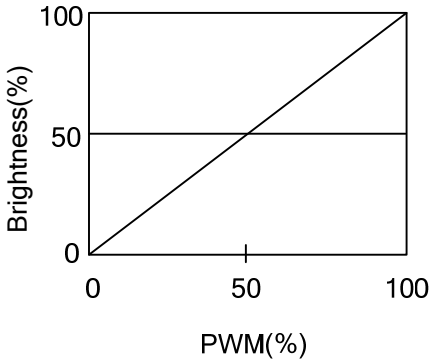
UL/DR：High

The interface CN2 is SM10B-SRSS-TB(LF)(SN) made by JST and pin assignment is as below:

Connector Name	Pin No.	Symbol	Function
SM10B-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	V_{DC}	Brightness dimming
	10	V_{PWM}	Brightness dimming

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





9.2 TIMING CHART

Horizontal timing

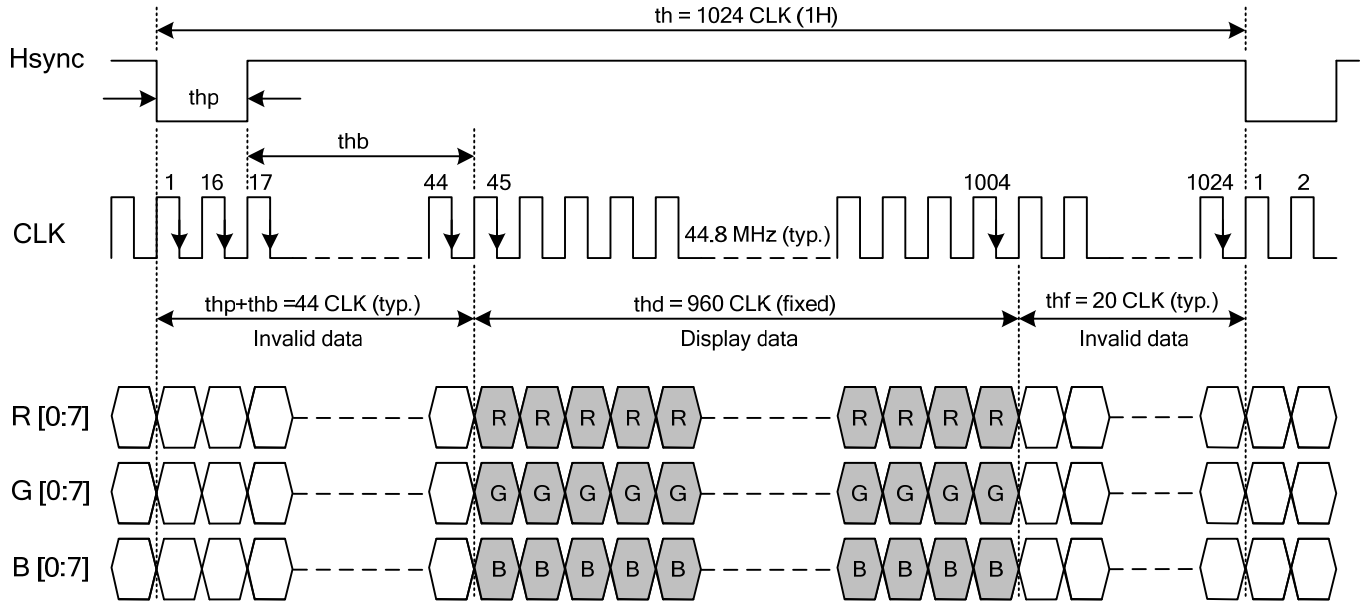


Fig. 9.1 Horizontal Timing of Synchronous Mode

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.

Vertical timing

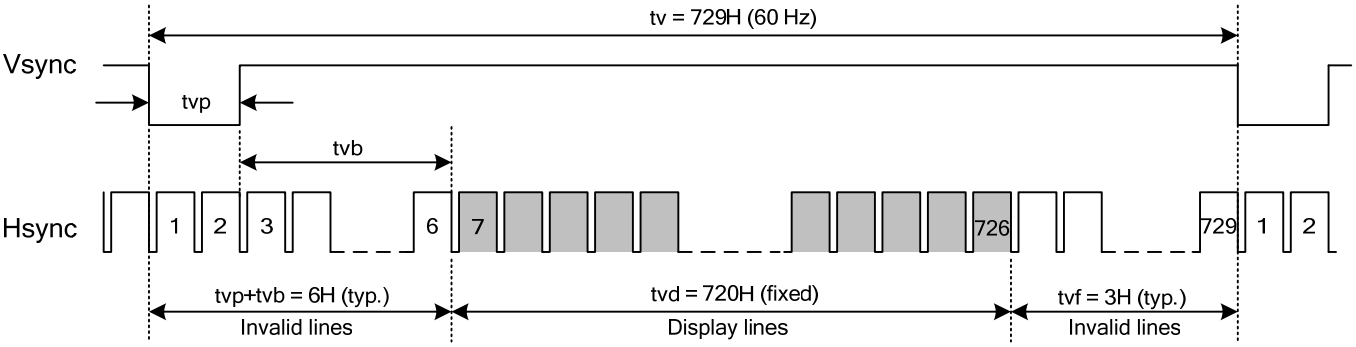


Fig. 9.2 Vertical Timing of Synchronous Mode

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

9.2 TIMING TABLE

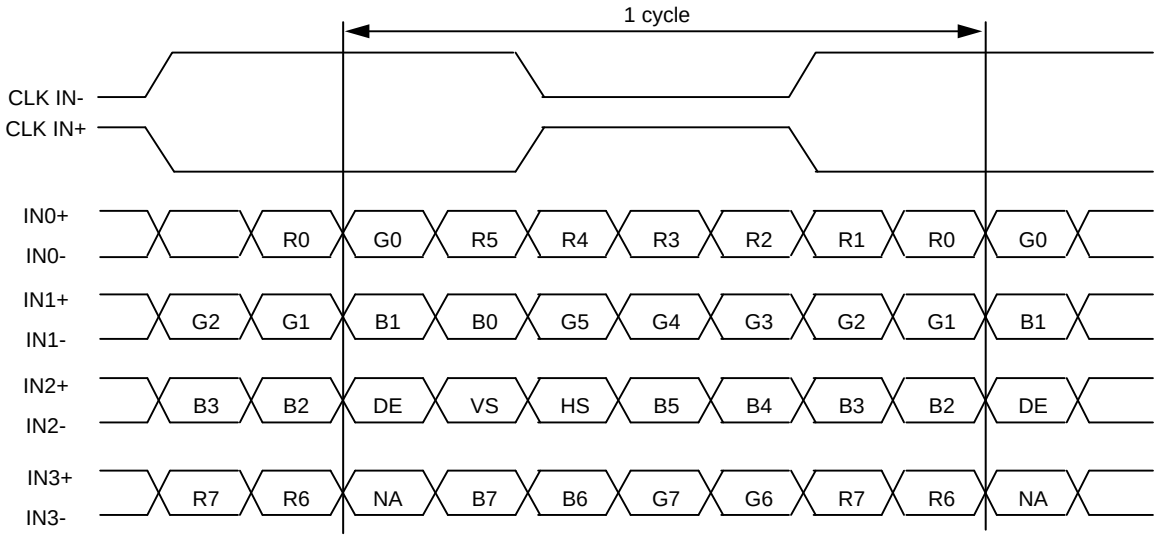
The column of timing sets including minimum, typical, and maximum as below are based on the best optical performance, frame frequency (f_{Frame}) = 60 Hz to define.

Item		Symbol	Min.	Typ.	Max.	Unit
Clock	CLK Frequency	fclk	44.4	44.8	45.25	M Hz
		-	22.1	22.3	22.5	ns
Hsync	Cycle Time	th	1024	1024	1074	DCLK
	Display Data	thd	960	960	960	
	Pulse Width	thp	5	16	46	
	Pulse Width	thb	2	28	43	
	Front Porch	thf	16	20	25	
	Horizontal “L” width +back porch	thd+thp	39	44	48	
	Horizontal total porch	thd+thp+thf	64	64	64	
Vsync	Cycle Time	tv	728	729	735	Line
	Display Line	tvd	720	720	720	
	Pulse Width	tvp	1	2	5	
	Pulse Width	tvb	1	4	5	
	Front Porch	tvf	3	3	5	
	Vertical “L” period +back porch	tvp+tvb	4	6	5	
	Vertical active area	tvp+tvb+tvf	9	9	9	
	Frame Frequency	f_{Frame}	56.2	60	60.69	Hz

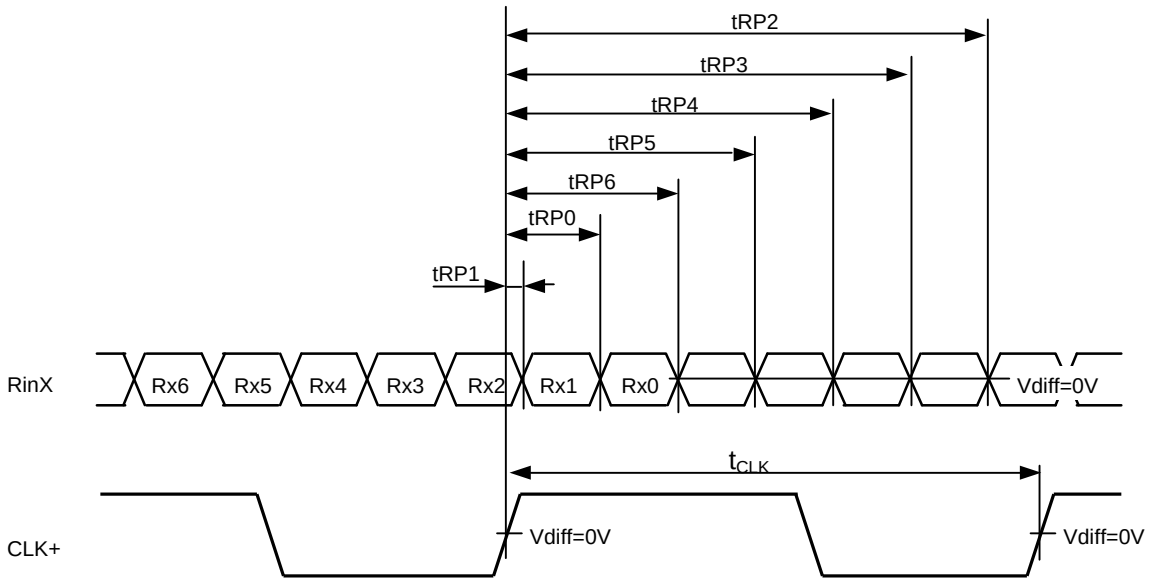
Note 1: For 2-port input, horizontal display period has the notation of the half of 1920.

9.3 LVDS Sequence

LVDS data format



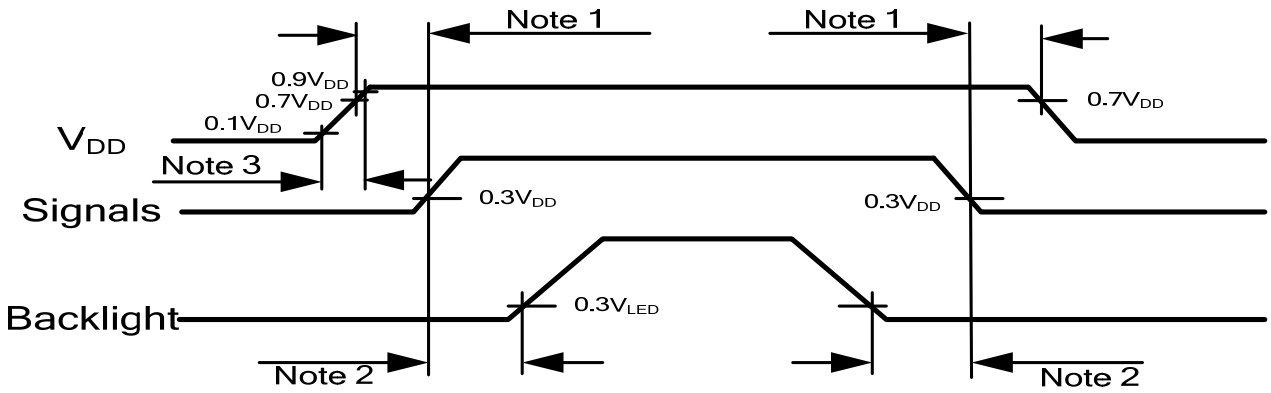
DE: Display Enable, VS: Vertical Signal, HS: Horizontal Signal, NA: Not Available



RinX= (RinX+)-(RinX-) (X=0, 1, 2, 3)

Item		Symbol	Min.	Typ.	Max.	Unit
CLK	Cycle frequency	1/tcLK	44.4	44.8	45.2	MHz
RinX (X=0,1,2,3)	0 data position	tRP0	1/7* t_{CLK} -0.3	1/7* t_{CLK}	1/7* t_{CLK} +0.3	ns
	1st data position	tRP1	-0.3	0	+0.3	
	2nd data position	tRP2	6/7* t_{CLK} -0.3	6/7* t_{CLK}	6/7* t_{CLK} +0.3	
	3rd data position	tRP3	5/7* t_{CLK} -0.3	5/7* t_{CLK}	5/7* t_{CLK} +0.3	
	4th data position	tRP4	4/7* t_{CLK} -0.3	4/7* t_{CLK}	4/7* t_{CLK} +0.3	
	5th data position	tRP5	3/7* t_{CLK} -0.3	3/7* t_{CLK}	3/7* t_{CLK} +0.3	
	6th data position	tRP6	2/7* t_{CLK} -0.3	2/7* t_{CLK}	2/7* t_{CLK} +0.3	

9.4 Power ON/OFF sequence



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.

Note 3: In order to avoid high Inrush current, V_{DD} rising time need to set more than 0.5ms.

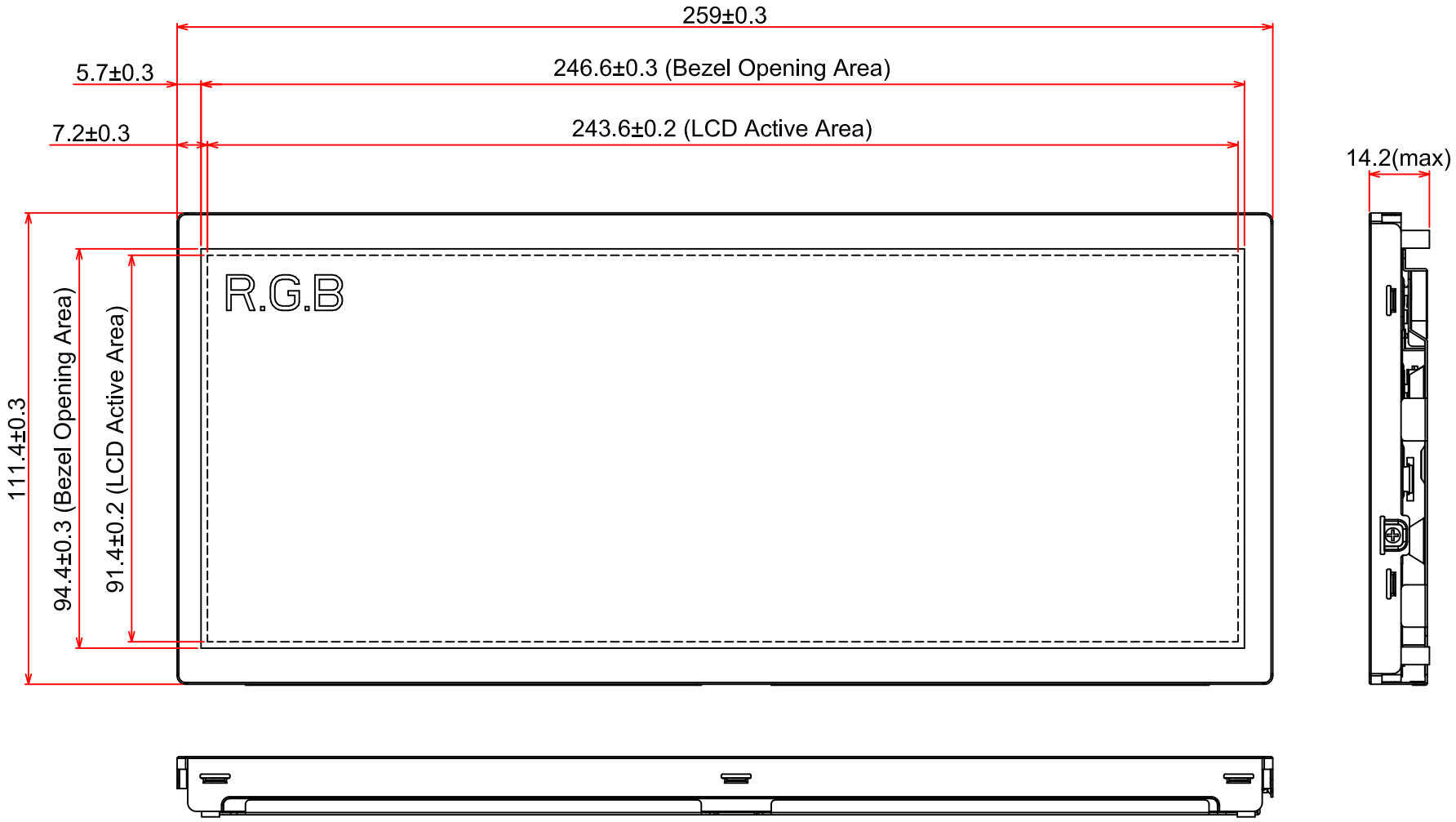
9.5 DATA INPUT for DISPLAY COLOR

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							LSB	MSB							LSB
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	H	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	L	H	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	L	H	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.

10. OUTLINE DIMENSIONS

10.1 FRONT VIEW



General Tolerance ±0.5mm
Scale : NTS
Unit : mm

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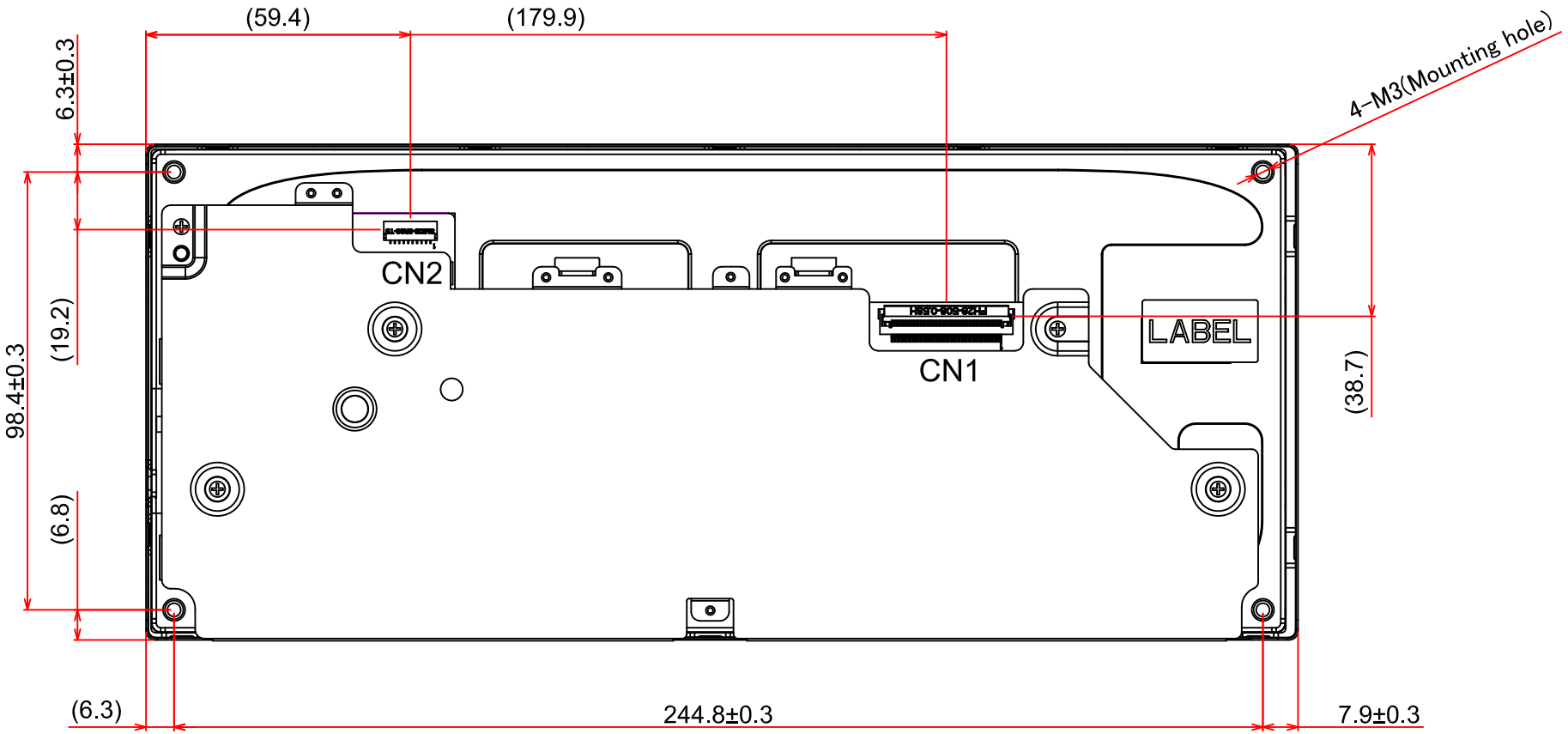
10.2 REAR VIEW



General Tolerance ±0.5mm
Scale : NTS
Unit : mm

KAOHSIUNG OPTO-ELECTRONICS INC.	SHEET No.	7B64PS 2710-TX26D206VM0BAA-1	PAGE	10-2/2

11. APPEARANCE STANDARD

The appearance inspection is performed in a 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. 11.1 The inspection should be performed within 45° when display is shut down. The inspection should be performed within 5° when display is power on.

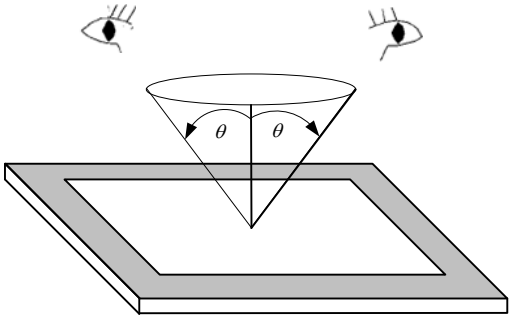


Fig. 11.1

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 between A zone and metal frame.

In terms of housing design, B zone is the recommended window area customers' housing should be located in.

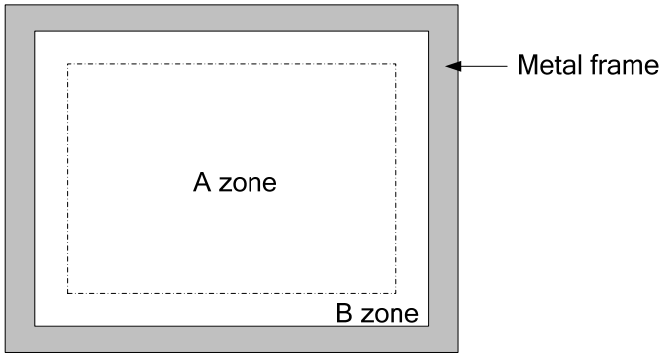


Fig. 11.2

11.2 LCD APPEARANCE SPECIFICATION

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. 11.3 and Fig. 11.4.

<table>
<tr><td>Item</td><td colspan="4">Criteria</td><td>Applied zone</td></tr>
<tr><td rowspan="4">Scratches</td><td>Length (mm)</td><td>Width (mm)</td><td>Maximum number</td><td>Minimum space</td><td rowspan="4">A, B</td></tr>
<tr><td>Ignored</td><td>W≦0.02</td><td>Ignored</td><td>-</td></tr>
<tr><td>L≦40</td><td>0.02＜W≦0.04</td><td>10</td><td>-</td></tr>
<tr><td>-</td><td>0.04＜W</td><td>Not allowed</td><td>-</td></tr>
<tr><td>Dent</td><td colspan="4">Serious one is not allowed</td><td>A</td></tr>
<tr><td>Wrinkles in polarizer</td><td colspan="4">Serious one is not allowed</td><td>A</td></tr>
<tr><td rowspan="4">Bubbles on polarizer</td><td colspan="2">Average diameter (mm)</td><td colspan="2">Maximum number</td><td rowspan="4">A</td></tr>
<tr><td colspan="2">D≦0.3</td><td colspan="2">Ignored</td></tr>
<tr><td colspan="2">0.3＜D≦0.5</td><td colspan="2">12</td></tr>
<tr><td colspan="2">0.5＜D</td><td colspan="2">Not allowed</td></tr>
<tr><td rowspan="13">1) Stains
2) Foreign Materials
3) Dark Spot</td><td colspan="4">Filamentous (Line shape)</td><td rowspan="4">A, B</td></tr>
<tr><td>Length (mm)</td><td colspan="2">Width (mm)</td><td>Maximum number</td></tr>
<tr><td>L≦2.0</td><td colspan="2">W≦0.03</td><td>Ignored</td></tr>
<tr><td>L≦3.0</td><td colspan="2">0.03＜W≦0.05</td><td>10</td></tr>
<tr><td>L≦2.5</td><td colspan="2">0.05＜W≦0.1</td><td>1</td><td rowspan="9">A, B</td></tr>
<tr><td colspan="4">Round (Dot shape)</td></tr>
<tr><td>Average diameter (mm)</td><td colspan="2">Maximum number</td><td>Minimum Space</td></tr>
<tr><td>D≦0.2</td><td colspan="2">Ignored</td><td>-</td></tr>
<tr><td>0.2＜D≦0.3</td><td colspan="2">10</td><td>10 mm</td></tr>
<tr><td>0.3＜D≦0.4</td><td colspan="2">5</td><td>30 mm</td></tr>
<tr><td>0.4＜D</td><td colspan="2">Not allowed</td><td>-</td></tr>
<tr><td>In total</td><td colspan="3">Filamentous + Round=10</td></tr>
<tr><td colspan="4">Those wiped out easily are acceptable</td></tr>
<tr><td rowspan="7">Dot-Defect
(Note 1)</td><td></td><td colspan="2">Type</td><td>Maximum number</td><td rowspan="7">A</td></tr>
<tr><td>Bright dot-defect</td><td colspan="2">1 dot</td><td>0</td></tr>
<tr><td rowspan="4">Dark dot-defect</td><td colspan="2">1 dot</td><td>5</td></tr>
<tr><td colspan="2">2 adjacent dot</td><td>2</td></tr>
<tr><td colspan="2">3 adjacent dot or above</td><td>Not allowed</td></tr>
<tr><td colspan="2">In total</td><td>5</td></tr>
<tr><td colspan="3">In total</td><td>5</td></tr>
<tr><td>Mura</td><td colspan="4">Invisible through 2% ND filter</td><td>A
(Note 2)</td></tr>
</table>

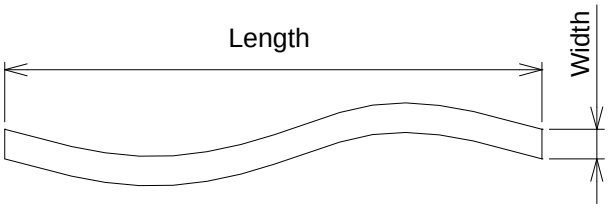


Fig 11.3

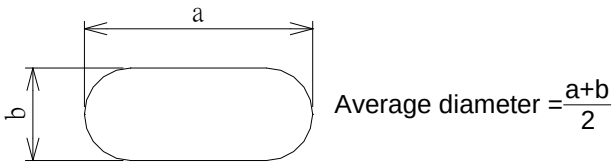


Fig 11.4

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

- For bright dot-defect, showing black pattern, visible with 5% ND filter is defined.
- For dark dot-defect, showing white pattern, defect size over 1/2 dot area is defined.
- 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. 11.5.
- The Density of dot defect is defined in the area within diameter ϕ =10mm.

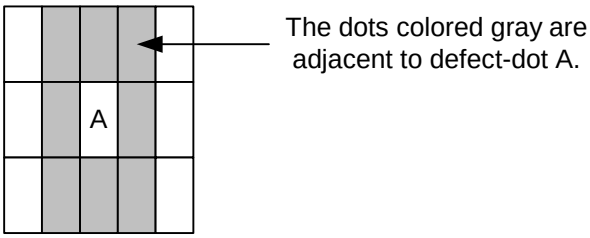
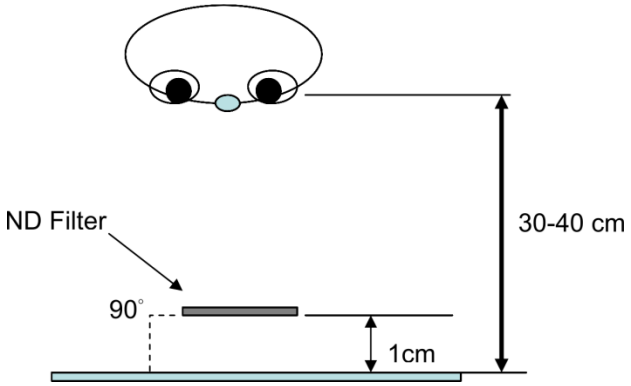


Fig. 11.5

Note 2: The inspection method with ND Filter is to hold it in front of the panel around 1 cm and inspect the panel with 35±5 cm distance for 1 second.



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.

2) 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.

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.

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 $25\,C^\circ$. 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.

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℃~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.

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.

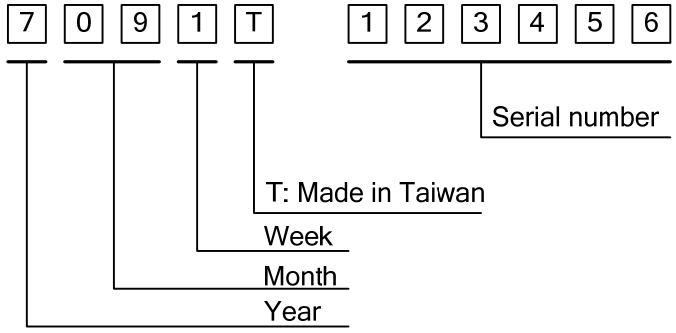


Fig. 13.1

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. 13.2

Label example:

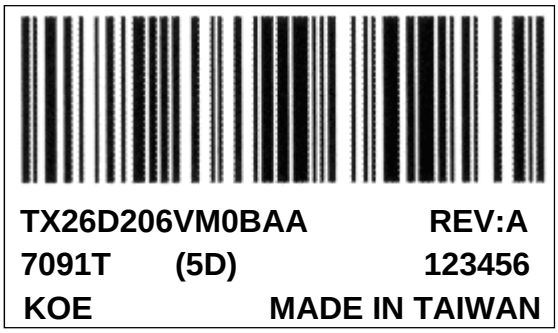


Fig. 13.2