

TFT Product Specification

- ◇ PRELIMINARY SPECIFICATION
- ◆ APPROVED SPECIFICATION

Part Number: FLC-156ITL2000SA1

Description: TFT 15.6''W 1366*768 LVDS 500CD

Prepared by: Joy

Version : 0.1

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Approved by	
Date	

Revision History

Version	Date	Page	Description	Note
V0.1	2018/3/8		First Edition	

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1. GENERAL DESCRIPTION

1.1 Description

15.6" is a Color Active Matrix Liquid Crystal Display Module composed of a TFT LCD panel and LED backlight system. The screen format is intended to support WXGA 1366x768 screen and 16.7M colors.

1.2 Product Summary

The following items are summary on the table under Ta=25 °C condition:

No.	Item	Specification	Unit
1	Display Size	15.6	Inch
2	Pixel Number	1366 (H) x RGB x 768 (V)	Pixels
3	Outline Dimension	363.80 (H) x 215.98 (V) x 9.30 (D)	mm
4	Active Area	344.23 (H) x 193.54 (V)	mm
5	Display Colors	16.7M	--
6	Pixel Arrangement	RGB vertical stripe	--
7	Display Mode	Normally White / Transmissive	--
8	Electrical Interface	LVDS	--
9	Surface Treatment	Anti-Glare, 3H	--
10	Brightness	500 (Typ.)	cd/m ²
11	Contrast Ratio	600 (Typ.)	--
12	Power Consumption (Typ)	Total 12.1	W
13	Operating Temperature	-10 ~ 60	°C
14	Storage Temperature	-20 ~ 60	°C



2. ABSOLUTE MAXIMUM RATING

2.1 Electrical Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max		
Power supply voltage	VCC	-0.3	-	6	V	(1)
Logic Input Voltage	VIN	-0.3	-	4	V	
Converter Voltage	LED_Vin	0	12.0	18.0		Duty=100% (1)(2)
Enable Voltage	LED_EN	0	3.3	7	V	
Backlight Adjust	LED_PWM	0	3.3	7	V	Pulse width \leq 10msec. and duty \leq 10%

Note (1) Permanent damage to the device may occur if max values are exceeded. Function operation should be restricted to the conditions described under normal operating conditions.

(2) Specified values are for input pin of LED light bar at Ta=25+/- 2°C

2.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Operating Temperature	Top	-10		60	°C	Ta=25°C
Storage Temperature	Tstg	-20		60	°C	

Note (1) Temperature and relative humidity range is shown in the figure below,

- (a) 90% RH Max.. (Ta<40°C)
- (b) Wet-bulb temperature should be 39°C Max. (Ta<40°C)
- (c) No condensation

(2) The temperature of panel surface should be 0°C min. and 65°C max.

3. ELECTRICAL CHARACTERISTICS

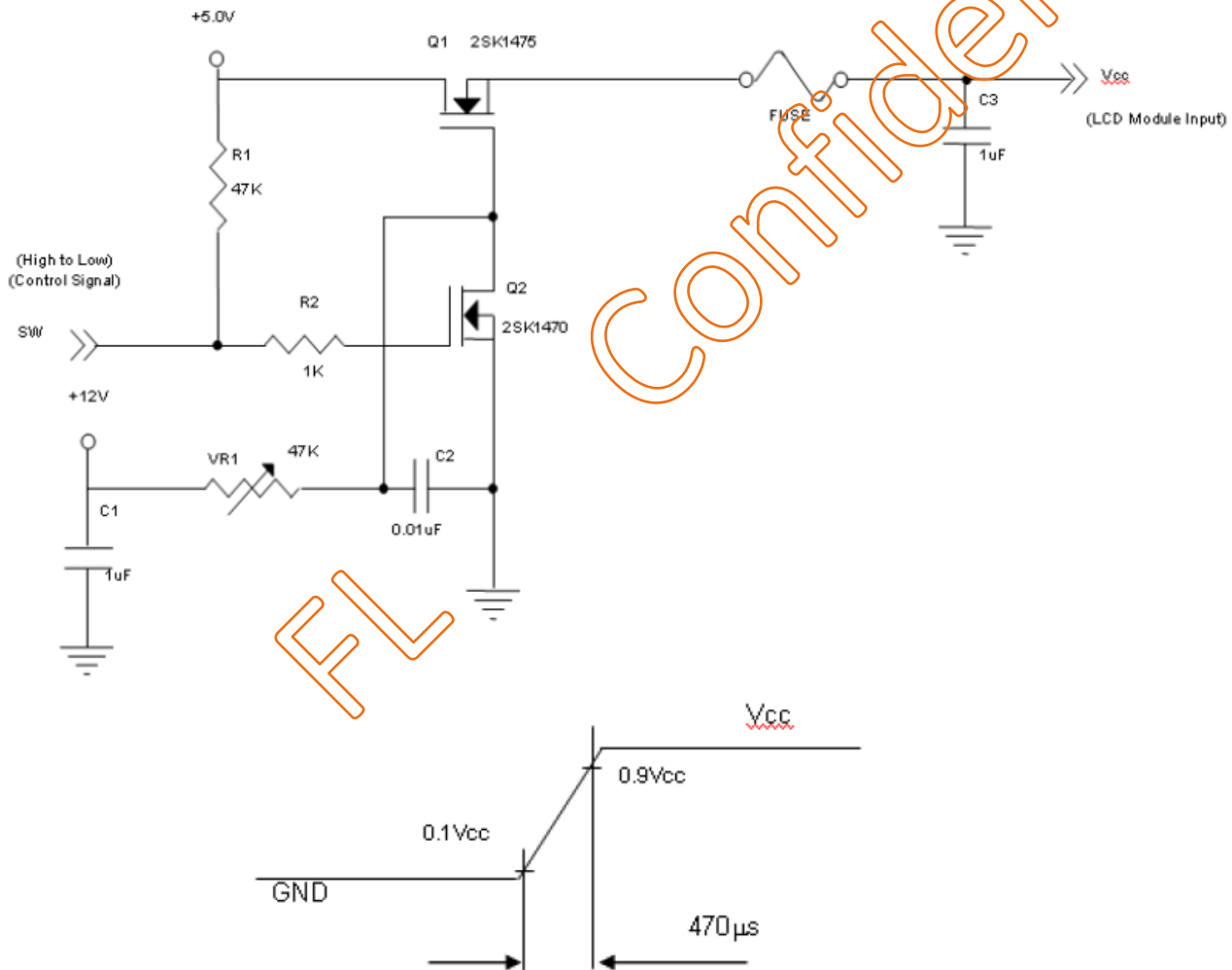
3.1 LCM

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	VCC	4.5	5	5.5	V	
Ripple Voltage	VRP	--	--	150	mV	
Rush Current	I _{RUSH}	--	--	3.0	A	(2)
Power Supply Current	White	--	0.17	0.22	A	(3)
	Black	--	0.24	0.29	A	
	Vertical Stripe	--	0.27	0.32	A	
Power Consumption	P _{LCD}	--	1.35	1.6	W	
LVDS differential input voltage	V _{id}	200	--	600	mV	-
LVDS common input voltage	V _{ic}	1.0	1.2	1.4	V	-
Terminating Resistor	R _T		100		Ohm	

Note (1) The assembly should be always operated within above ranges.

T_a = 25 ± 2 °C

Note (2) Measurement Conditions:



Note (3) The specified power supply current is under the conditions at $V_{cc}=5V$, $F_r=60Hz$, whereas a power dissipation check pattern below is displayed

a. White Pattern



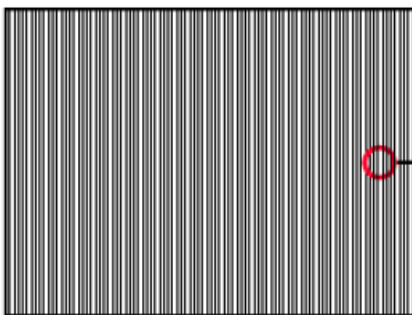
Active Area

b. Black Pattern



Active Area

c. Vertical Stripe Pattern

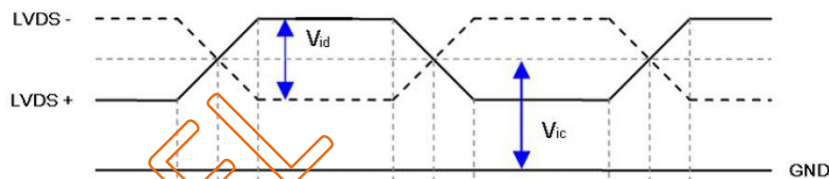


Active Area

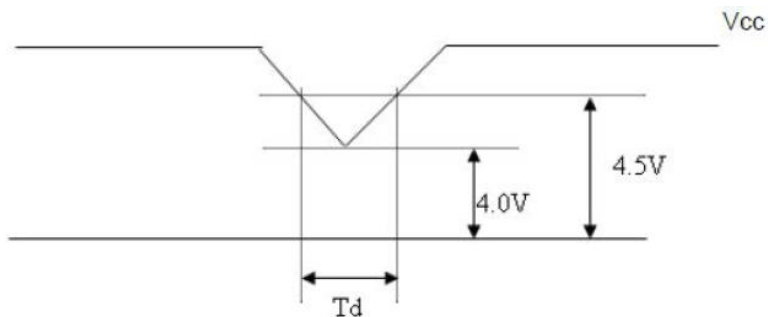


Note (4) The power consumption is specified at the pattern with the max. current.

Note (5) VID waveform condition



Note (6) Power Dip condition



Dip condition: $4.0 \leq V_{cc} \leq 4.5$, $T_d \leq 20ms$

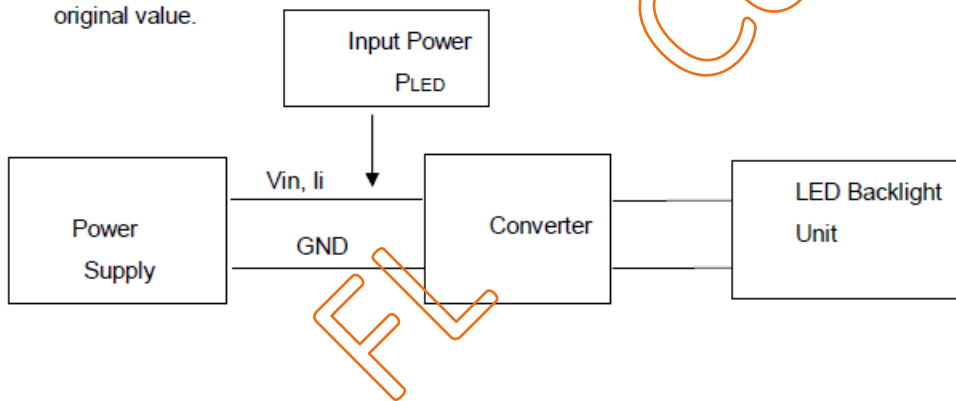
3.2 Backlight Unit

Parameter guideline for LED driving is under stable conditions at 25°C (Room Temperature):

Symbol	Parameter	Min.	Typ.	Max.	Unit	Note	
LED_Vin	Converter Power Supply Voltage	10.8	12.0	13.2	V		
li	Converter Power Supply Current	0.6	0.8	1.0	A	@LED_Vi=12V (Duty 100%)	
P _{LED}	BLU Power consumption	--	--	10.5	W	@LED_Vi=12V (Duty 100%)	
LED_EN	EN Control Level	Backlight on	2.0	3.3	5.0	V	
		Backlight off	0	0	0.8	V	
LED_PWM	PWM Dimming Control Level	PWM High Level	2.0	3.3	5.0	V	
		PWM Low Level	0	0	0.15	V	
	PWM Dimming Control Duty Ratio	10	--	100	%		
f _{PWM}	PWM Dimming Control Frequency	190	200	20K	Hz		
LL	LED life Time (Typical)	50,000	--	--	Hrs	(2)	

Note (1) LED light bar input voltage and current are measured by utilizing a true RMS multimeter as shown below.

Note (2) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at $T_a = 25 \pm 2 \text{ }^\circ\text{C}$ and $I = 70 \text{ mA}$ (per chip) until the brightness becomes $\cong 50\%$ of its original value.



4. SIGNAL CHARACTERISTICS

4.1 Interface Timing

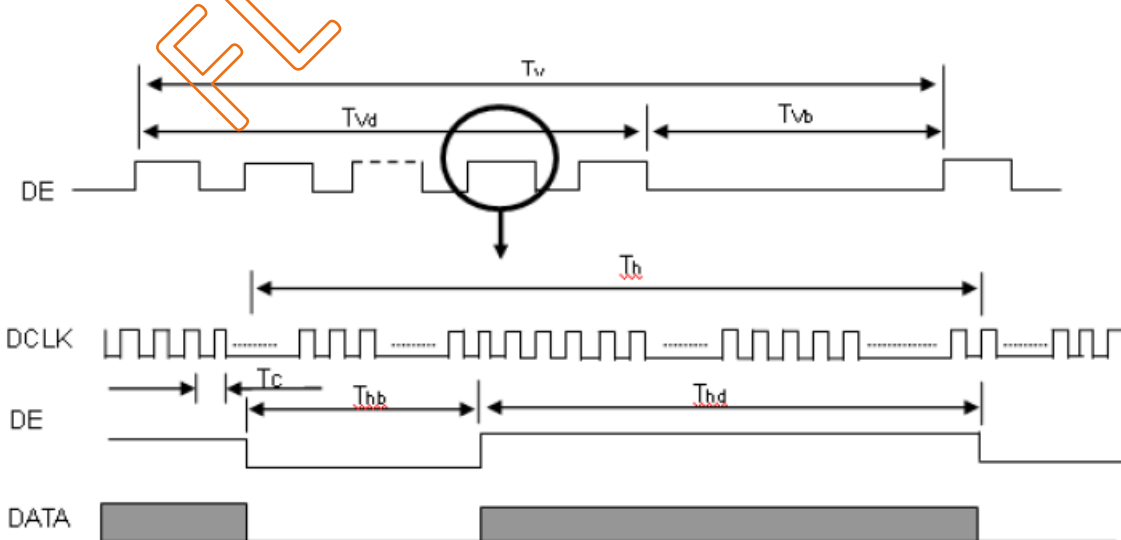
4.1.1 Timing Characteristics:

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	63	76	96	MHZ	
	Period	Tc	--	13.15	--	ns	
	Input cycle to cycle jitter	Trcl	-0.02*Tc	--	0.02*Tc	ns	(3)
	Input Clock to data skew	TLVCCS	-0.02*Tc	--	0.02*Tc	ps	(4)
	Spread spectrum modulation range	F _{clk_{in}_mod}	Fc*98%	--	Fc*1.02	MHZ	(5)
	Spread spectrum modulation frequency	F _{SSM}	--	--	200	KHz	
Vertical Display Term	Frame Rate	Fr	50	60	76	Hz	Tv=Tvd+Tvb
	Total	Tv	800	806	815	Th	--
	Display	Tvd	768	768	768	Th	--
	Blank	Tvb	32	38	47	Th	--
Horizontal Display Term	Total	Th	1500	1560	1570	Tc	Th=Thd+Thb
	Display	Thd	1366	1366	1366	Tc	--
	Blank	Thb	134	194	204	Tc	--

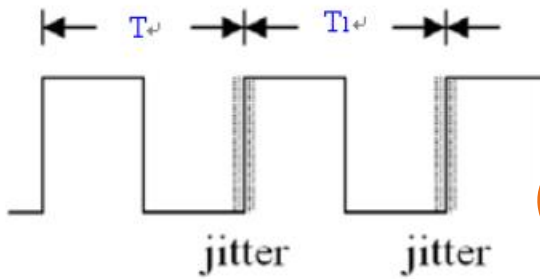
Note (1) Because this module is operated by DE only mode. Hsync and Vsync input signals are ignored.

Note (2) The Tv must be integer, otherwise, this module would operate abnormally.

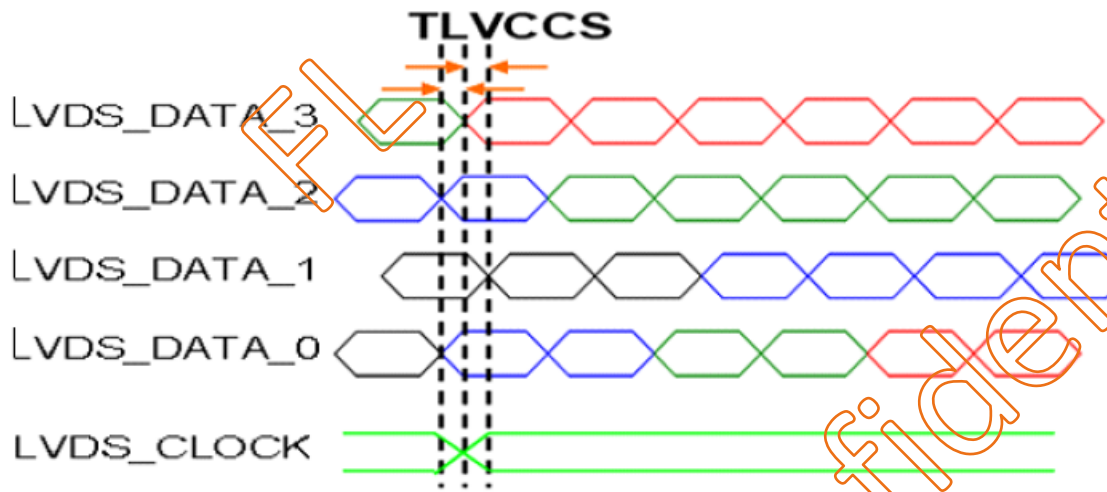
INPUT SIGNAL TIMING DIAGRAM



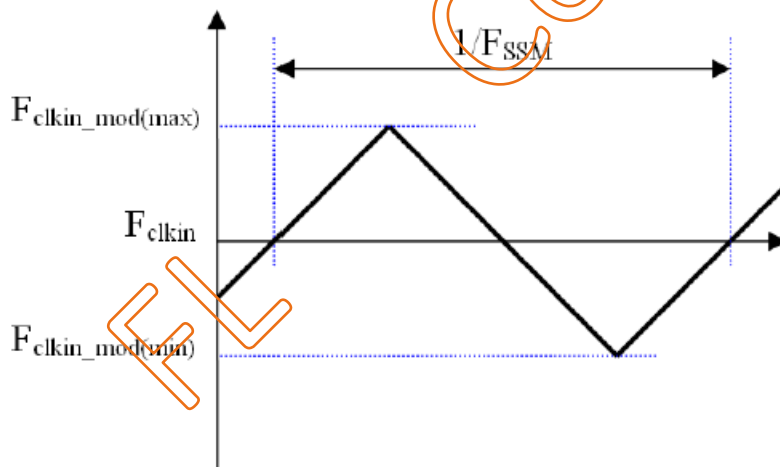
Note (3) The input clock cycle-to-cycle jitter is defined as below figures. $Trcl = |T1 - T|$



Note (4) Input Clock to data skew is defined as below figures.

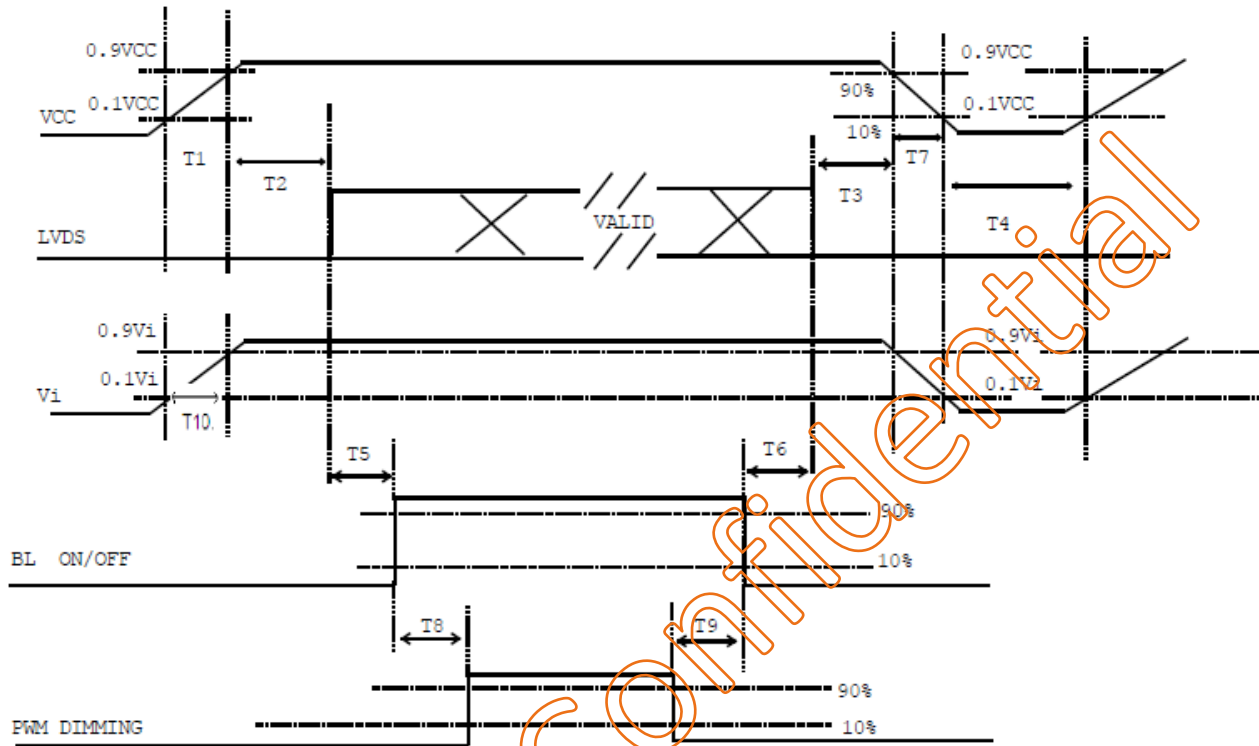


Note (5) The SSCG (Spread spectrum clock generator) is defined as below figures.



4.1.2 Power ON/OFF Sequence

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.



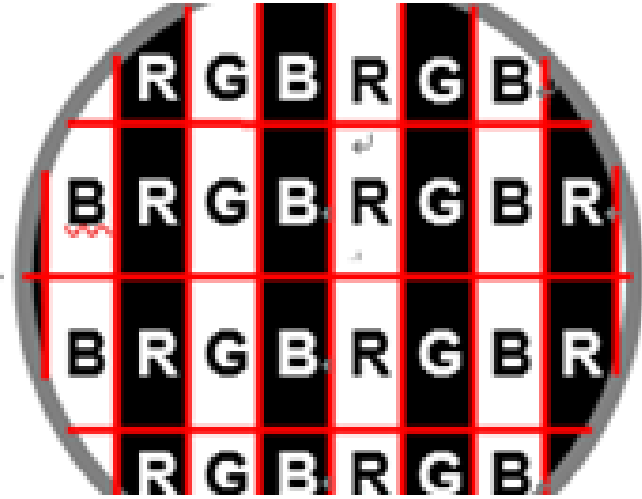
Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	20	-	-	ms
T7	5	-	300	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20	--	--	ms

4.2 Pixel Format Image



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5. INTERFACE PIN DESCRIPTION

5.1 LCM Connector PIN Assignment

	Symbol	Description	Note
1	NC	No Connection	-
2	NC	No Connection	-
3	NC	No Connection	-
4	GND	Ground	-
5	RX0-	Negative LVDS differential data input Channel0	-
6	RX0+	Positive LVDS differential data input Channel0	-
7	GND	Ground	-
8	RX1-	Negative LVDS differential data input Channel 1	-
9	RX1+	Positive LVDS differential data input Channel 1	-
10	GND	Ground	-
11	RX2-	Negative LVDS differential data input Channel 2	-
12	RX2+	Positive LVDS differential data input Channel 2	-
13	GND	Ground	-
14	RXCLK-	Negative LVDS differential clock input	-
15	RXCLK+	Positive LVDS differential clock input	-
16	GND	Ground	-
17	RX3-	Negative LVDS differential data input Channel 3	-
18	RX3+	Positive LVDS differential data input Channel 3	-
19	GND	Ground	-
20	NC	No Connection	-
21	NC	No Connection	-
22	NC	No Connection	-
23	GND	Ground	-
24	GND	Ground	-
25	GND	Ground	-
26	Vcc	+5V power supply	-
27	Vcc	+5V power supply	-
28	Vcc	+5V power supply	-
29	Vcc	+5V power supply	-
30	Vcc	+5V power supply	-

Note
(1)

Connector Part no.: MSCK2407P30.D(STM)

Note (1) The first pixel is odd.

Note (2) Input signal of even and odd clock should be the same timing.

5.2 Backlight and LED Driver Connector PIN Assignment

Pin No	Symbol	Description	Remark
1	Vi	Converter input voltage	12V
2	V _{GND}	Converter ground	Ground
3	EN	Enable pin	3.3V
4	ADJ	Backlight Adjust	PWM Dimming (Hi: 3.3V _{DC} , Lo: 0V _{DC})
5	NC	Not Connect	

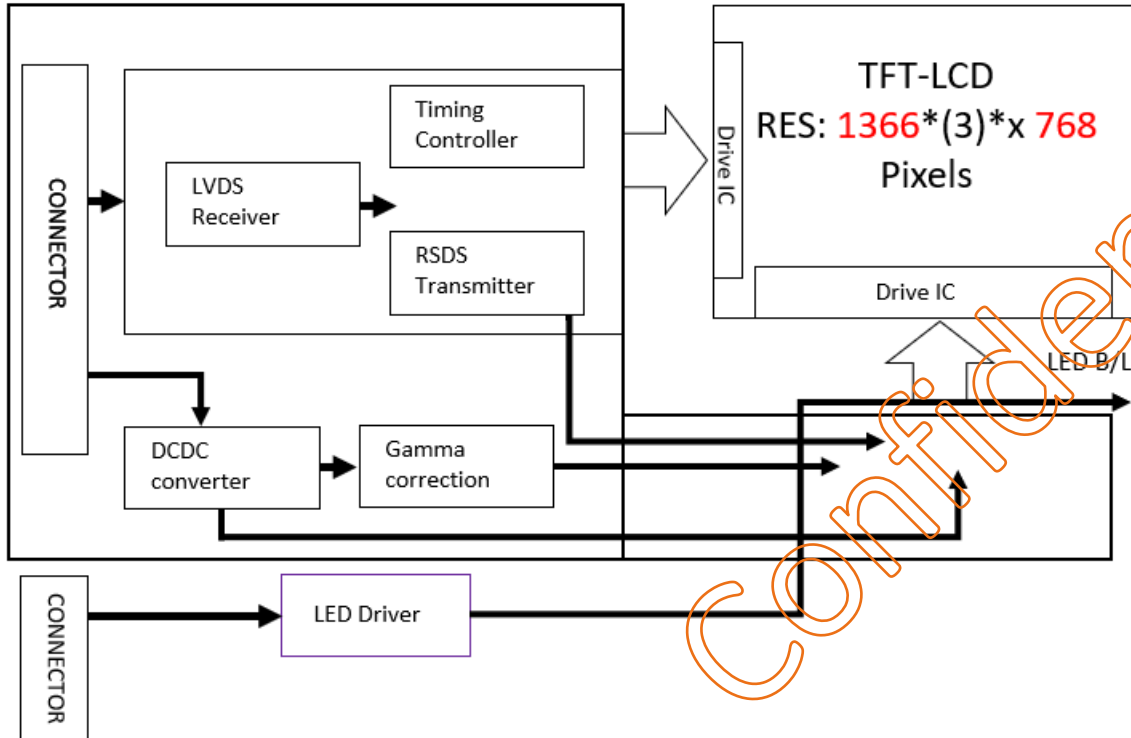
Note (1) Connector Part No.: CI4205M2HRP-NH, CVILUX

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6. BLOCK DIAGRAM

The following diagram shows the functional block of the TFT module:



7. OPTICAL CHARACTERISTIC

The optical characteristics are measured under stable conditions at room temperature.

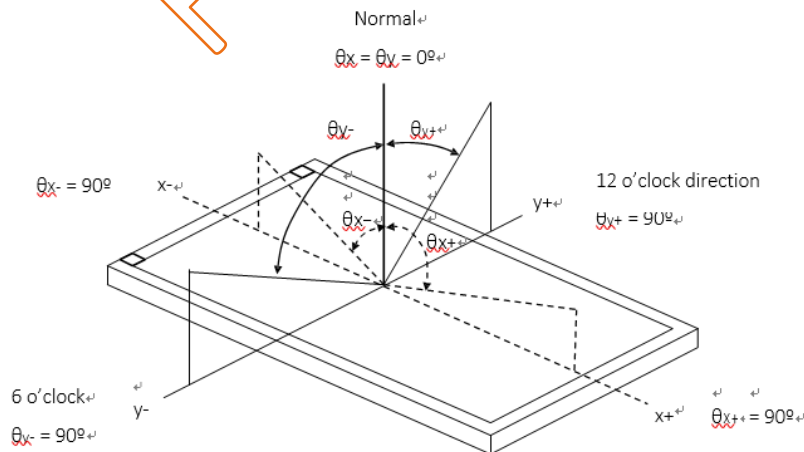
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note		
Contrast Ratio		CR	$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing angle at normal direction	400	600	-	-	(2)(5)		
Response Time		T_R		-	3	8	ms	(3)		
		T_F		-	8	13	ms			
Center Luminance of White		LC		400	500	-	cd/m ²	(4)(5)		
White Variation		δW		70	--	--	%	(5)(6)		
Chromaticity	Red	R_x		$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing angle at normal direction	Typ.	-0.045	Typ.	+0.045	(1) (5)	
		R_y	0.627							-
	Green	G_x	0.339							-
		G_y	0.328							-
	Blue	B_x	0.590							-
		B_y	0.160							-
	White	W_x	0.063							-
		W_y	0.313							-
Viewing Angle	Horizontal	θ_{x+}	70	80	-	Deg.	(1)(5)			
		θ_{x-}	70	80	-					
	Vertical	θ_{y+}	65	75	-					
		θ_{y-}	65	75	-					

The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance <2 lux, and at room temperature).

The ambient temperature is $25^\circ\text{C} \pm 2^\circ\text{C}$ and ambient humidity is $50 \pm 10\% \text{RH}$.

Note 1: Definition of Viewing Angle

Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or the vertical clock direction with respect to the optical axis which is normal to the LCD surface

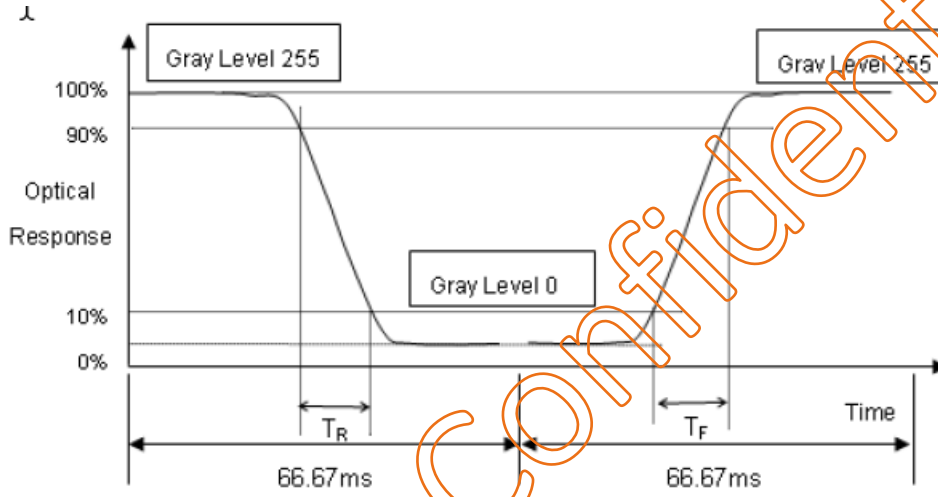


Note 2: Definition of Contrast Ratio (CR)

Measure the viewing angle of $\Theta = 0$ and at the center of the LCD surface. Luminance with all pixels in white state divide by Luminance with all pixels in Black state

Note 3 Definition of Response Time:

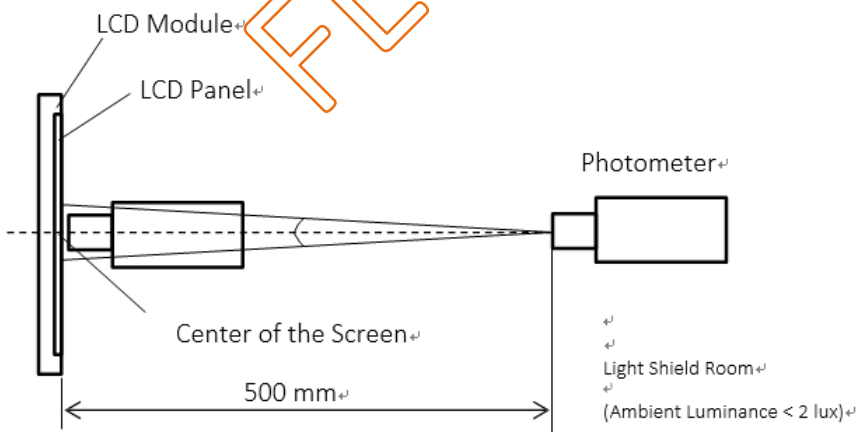
The response time is set initially by defining the “Rising Time (T_R)” and the “Falling Time (T_F)” respectively. Please refer the figure to the followings:



Note 4: Definition of Brightness (Lc)

Measure the center area of the panel and the viewing angle of the $\theta_x = \theta_y = 0^\circ$

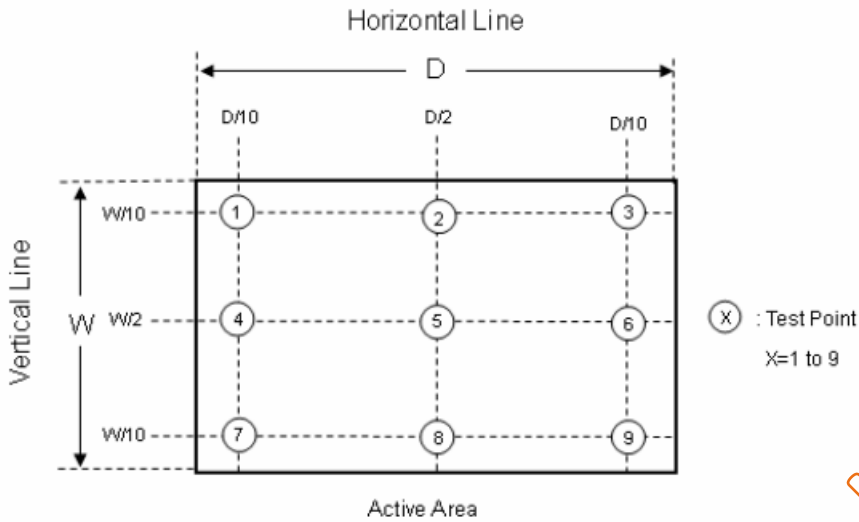
Note 5: The method of optical measurement:



Note 6: Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

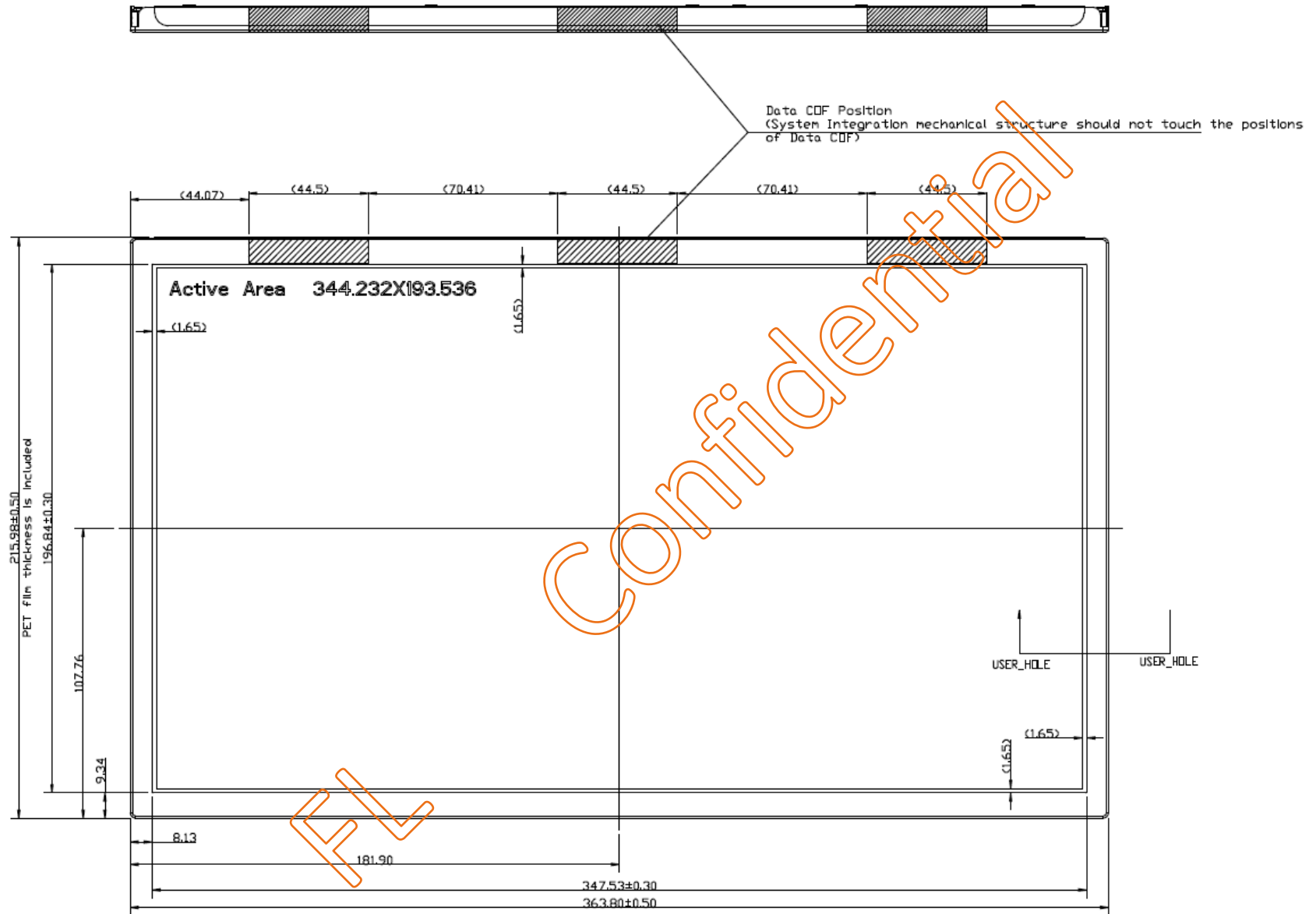
$$\delta W = \text{Maximum [L (1), L (2), L (3), L (4) \sim L (9)]} / \text{Minimum [L (1), L (2), L (3), L (4) \sim L (9)]}$$

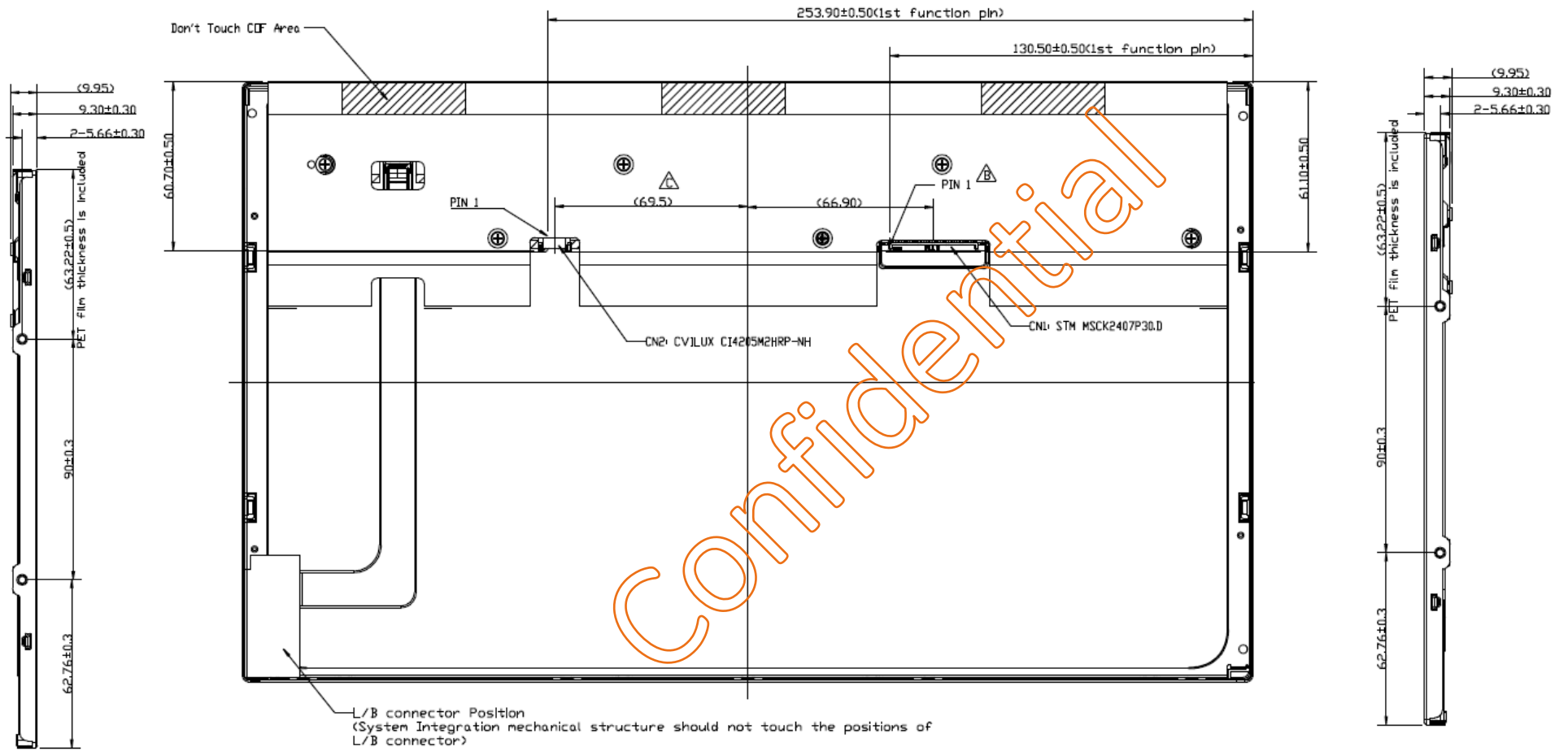


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8. DIMENSION AND DRAWING





9. PRECAUTION AND PRODUCT HANDLING

- Do not apply the external force such as bending or twisting to the LCD panel and backlight during assembly.
- Do not insert and plug out the input connector while the LCD panel is operating.
- Do not take apart the panel or frame from LCD module assembly or insert anything into the backlight unit.
- Do not keep the same pattern in a long period of time, it may cause image sticking on LCD panel. Can use shuffle content periodically if fixed pattern is displayed on the screen.
- Do not touch the display area with bare hands, this will stain the display area.
- Pay attention to handle lead wire of backlight, that is not tugged in connect with LED driver.
- Do not change variable resistance settings in LCD panel, it may cause not satisfy of LCD characteristics specification.
- The surface of LCD panel's polarizer is very soft and easily scratched, please use a very soft dry cloth without chemicals for cleaning.
- To avoid the static electricity to damage the CMOS LSI, the operator should be grounded when in contact with the LCD panel, and also to all electrical equipment.
- Need to follow the correct power frequency when LCD panel is connecting and operating, this can avoid damage to CMOS LSI during latch-up.
- Need to store the LCD panel indoor without the exposure of sunlight where the temperature is $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the humidity is below 60% RH.

