

## TFT Product Specification

- ◇ PRELIMINARY SPECIFICATION
- ◆ APPROVED SPECIFICATION

**Part Number: FLC-150GML2000SA2**

Description: 15" TFT LCD 500CD with LVDS interface, 1024x768 format  
can display 262K/16.7M colors

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Approved by	
Date	

## Revision History

Version	Date	Page	Description	Note
V1.0	2020/06/23		First Edition	
V1.1	2020/06/25		Update Bits	

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# 1. GENERAL DESCRIPTION

## 1.1 Description

15" 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 the XGA, 1024 x768 screen and 16.7M/262K 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	Inch
2	Pixel Number	1024 (H) x RGB x 768 (V)	Pixels
3	Outline Dimension	326.5 (H) x253.5 (V) x9.1 (D)	mm
4	Active Area	304.1 (H) x 228.1 (V)	mm
5	Display Colors	262K/ 16.7M	color
6	Pixel Arrangement	RGB vertical stripe	--
7	Display Mode	MVA / Normally Black / Transmissive	--
8	Electrical Interface	LVDS	--
9	Surface Treatment	Hard Coating (3H), Anti-Glare	--
10	Brightness	500 (Typ.)	cd/m2
11	Contrast Ratio	2500 (Typ.)	--
12	Total Power Consumption (Typ)	12.8	-W



## 2. ABSOLUTE MAXIMUM RATING

### 2.1 Electrical Absolute Rating

Item	Symbol	Values		Unit	Note
		Min	Max.		
Power supply voltage	VCC	-0.3	4	V	
Converter Voltage	Vi	-0.3	18	V	
Enable Voltage	EN	--	5.5	V	
Backlight Adjust	Dimming	--	5.5	V	

Note 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.

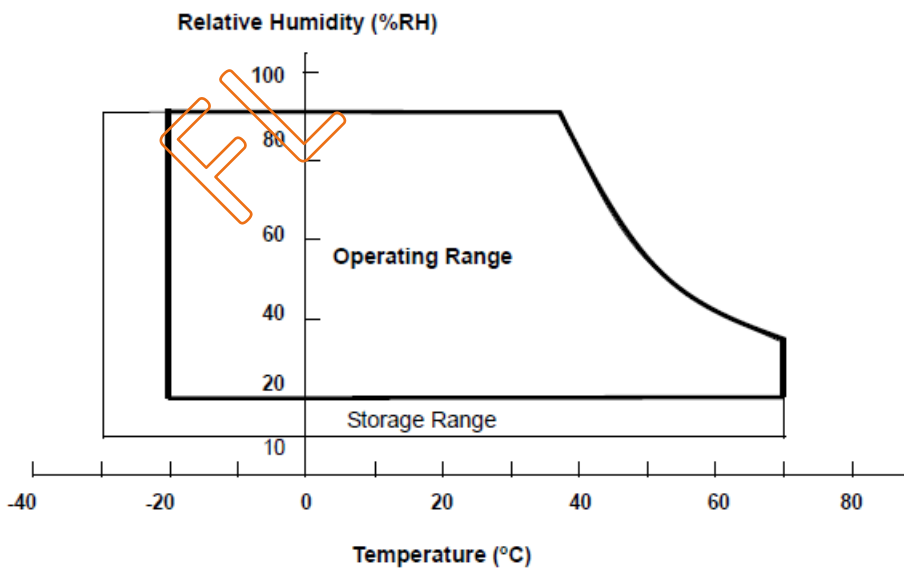
### 2.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Operating Temperature	Top	-30		80	°C	
Storage Temperature	Tstg	-40		80	°C	

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

Note (2) 90%RH Max. ( $T_a < 40^\circ\text{C}$ )

Note (3) Wet-bulb temperature should be  $39^\circ\text{C}$  Max.



### 3. ELECTRICAL CHARACTERISTICS

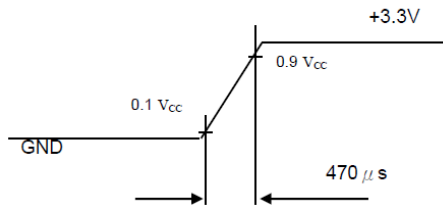
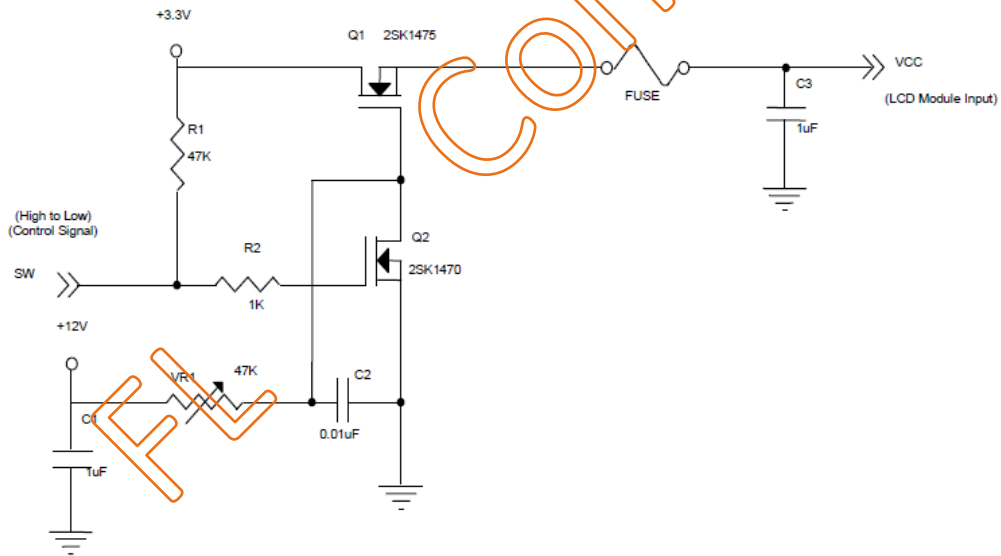
#### 3.1 LCM

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V <sub>CC</sub>	3.0	3.3	3.6	V	
Ripple Voltage	V <sub>RP</sub>	--	--	100	mVp-p	
Rush Current	I <sub>RUSH</sub>	-	-	2.0	A	(2)
Power Supply Current	White	--	800	960	mA	(3)
	Black	--	670	800	mA	
LVDS differential input voltage	VID	200	-	600	mV	-
LVDS common input voltage	VIC	1.0	1.2	1.4	V	-
Differential Input Voltage for LVDS Receiver Threshold H level	"H" Level	--	--	100	mV	
Differential Input Voltage for LVDS Receiver Threshold L level	"L" Level	-100	--	--	mV	
Terminating Resistor	R <sub>T</sub>		100		Ohm	

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

T<sub>a</sub> = 25 ± 2 °C

Note (2) Measurement Conditions:



Note (3) The specified power supply current is under the conditions at V<sub>DD</sub>=3.3V, T<sub>a</sub>=25 ± 2 °C, DC current and f<sub>v</sub>=60Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



Active Area

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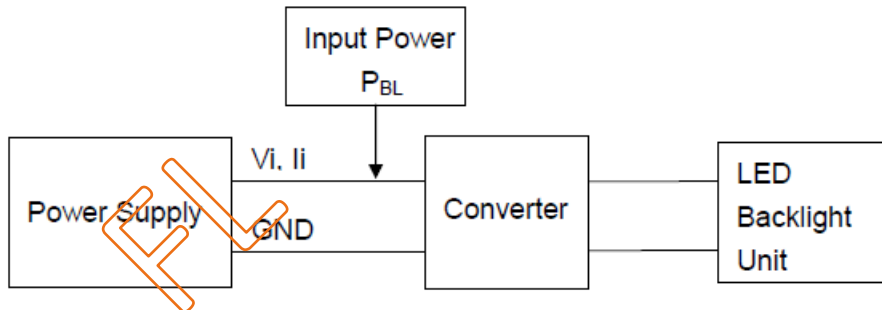


### 3.2 Backlight Unit

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Note	
$V_i$	Converter Power Supply Voltage	10.8	12.0	13.2	V		
$I_i$	Converter Power Supply Current	0.5	0.65	0.8	A	@ $V_i=12V$ (Duty 100%)	
$P_{BL}$	BLU Power consumption	--	7.8	9.6	W	@ $V_i=12V$ (Duty 100%)	
--	EN Control Level	Backlight on	2.0	3.3	5.0	V	
		Backlight off	0	--	0.8	V	
--	PWM Dimming Control Level	PWM High Level	2.0	3.3	5.0	V	
		PWM Low Level	0	--	0.15	V	
--	PWM Dimming Control Duty Ratio	1	--	100	%	@200Hz	
$f_{PWM}$	PWM Dimming Control Frequency	190	200	20K	Hz	(2)	
LL	LED life Time (Typical)	50,000	70,000	--	Hrs	(3)	

Note (1) LED current is measured by utilizing a high frequency current meter as shown below:

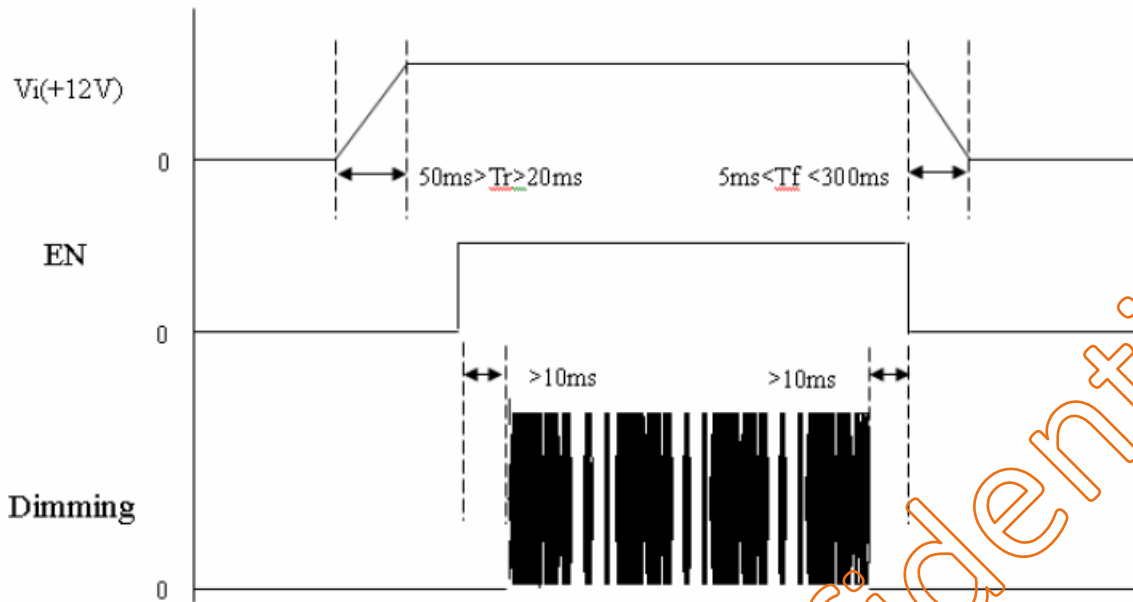


Note (2) At 20k Hz PWM control frequency, duty ratio range is restricted from 20% to 100%.

Note (3) The life time of LED is estimated data and defined as the time when it continues to operate under the conditions at  $T_a=25 \pm 2$  °C and Duty 100% until the brightness becomes  $\leq 50\%$  of its original value. Operating LED under high temperature environment will reduce life time and lead to color shift.



Power sequence and control signal timing are shown in the following figure

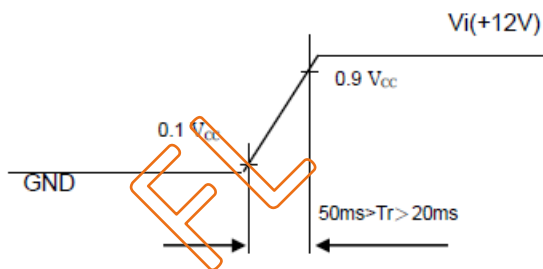


Note : While system is turned ON or OFF, the power sequences must follow as below descriptions

Turn ON sequence:  $V_i(+12V) \rightarrow EN \rightarrow$  Dimming

Turn OFF sequence: Dimming  $\rightarrow EN \rightarrow V_i(+12V)$

Note (4)



## 4. SIGNAL CHARACTERISTICS

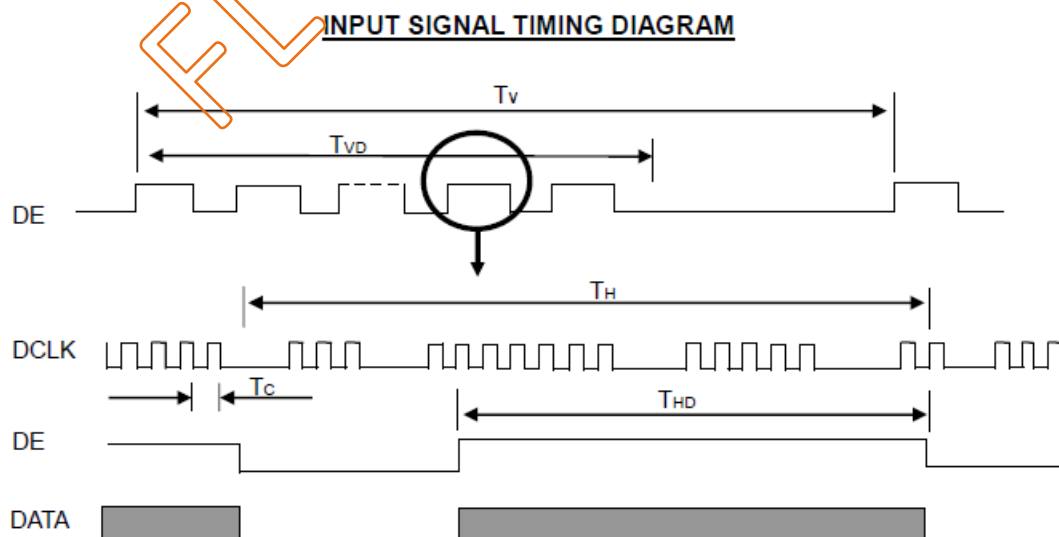
### 4.1 Interface Timing

#### 4.1.1 Timing Characteristics:

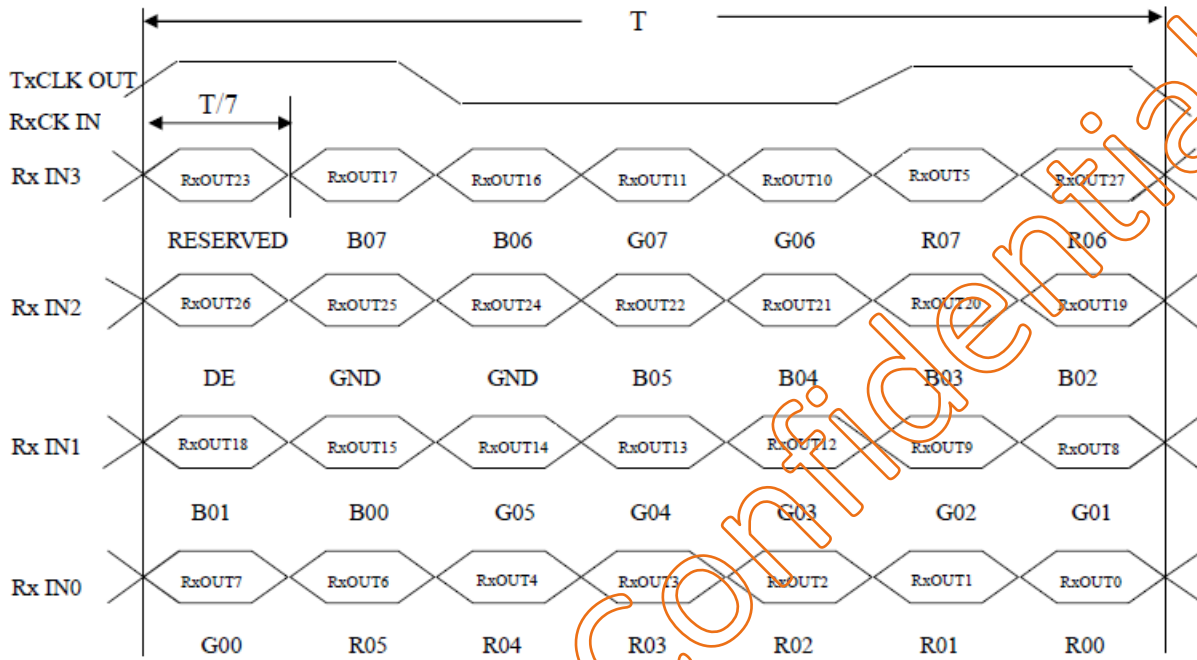
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F <sub>c</sub>	53.35	65	80	MHZ	
	Period	T <sub>c</sub>	12.5	15.38	18.75	ns	
	Input cycle to cycle jitter	Trd	--	--	200	ns	(a)
	Input Clock to data skew	TLVCCS	-0.02*T <sub>c</sub>	--	0.02*T <sub>c</sub>	ps	(b)
	Spread spectrum modulation range	F <sub>clk_in_mod</sub>	--	--	1.02*F <sub>c</sub>	MHZ	(c)
	Spread spectrum modulation frequency	F <sub>SSM</sub>	--	--	200	KHz	
Vertical Display Term	Frame Rate	Fr	55	60	70	Hz	
	Total	T <sub>v</sub>	780	806	840	Th	T <sub>v</sub> =T <sub>vd</sub> +T <sub>vb</sub>
	Display	T <sub>vd</sub>	768	768	768	Th	-
	Blank	T <sub>vb</sub>	T <sub>v</sub> -T <sub>vd</sub>	38	T <sub>v</sub> -T <sub>vd</sub>	Th	-
Horizontal Display Term	Total	T <sub>h</sub>	1240	1344	1360	T <sub>c</sub>	T <sub>h</sub> =T <sub>hd</sub> +T <sub>hb</sub>
	Display	T <sub>hd</sub>	1024	1024	1024	T <sub>c</sub>	-
	Blank	T <sub>hb</sub>	T <sub>h</sub> -T <sub>hd</sub>	320	T <sub>h</sub> -T <sub>hd</sub>	T <sub>c</sub>	-

Note (1) Since this assembly is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this assembly would operate abnormally.

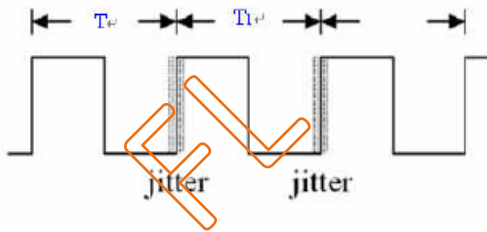
Note(2) The T<sub>v</sub>(T<sub>vd</sub>+T<sub>vb</sub>) must be integer, otherwise, the module would operate abnormally.



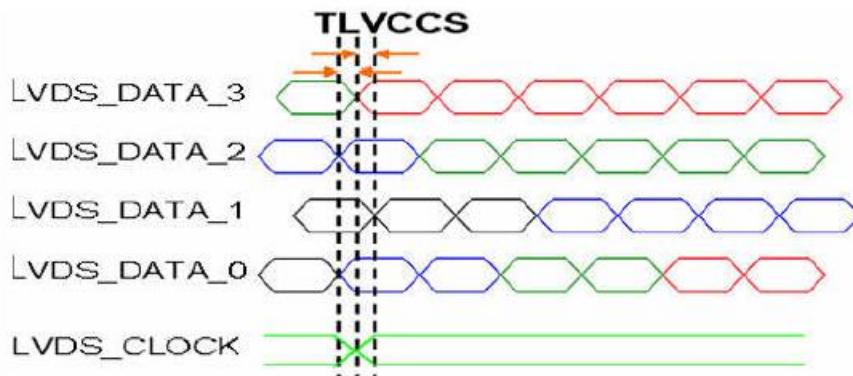
### TIMING DIAGRAM of LVDS



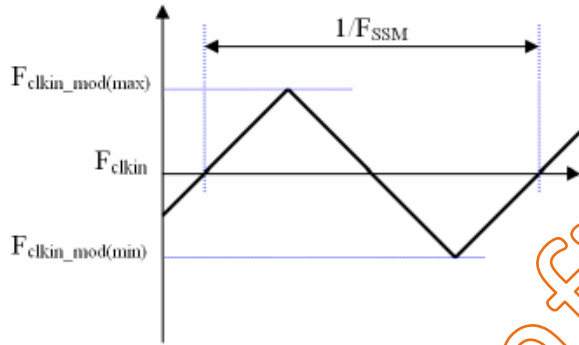
Note (a) The input clock cycle-to-cycle jitter is defined as below figures.  $Trcl = |T_1 - T_1|$



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



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

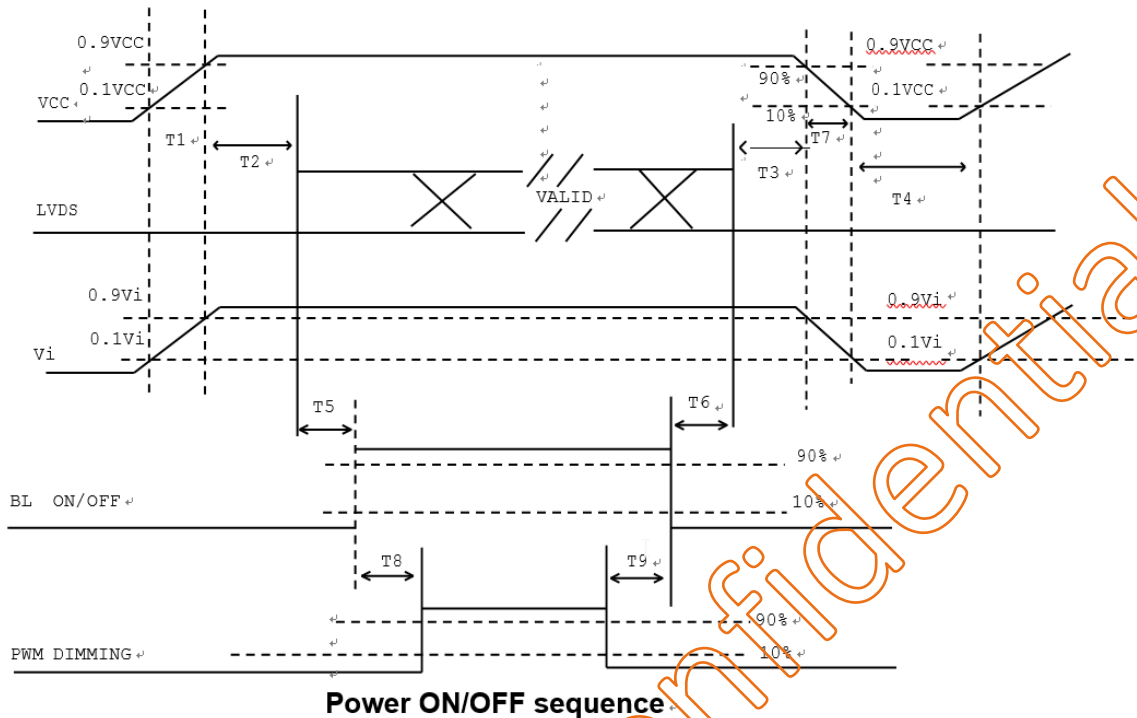


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### 4.1.2 Power ON/OFF Sequence

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	Ty	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	200	-	-	ms
T7	5	-	300	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20	-	50	ms

## 5. INTERFACE PIN DESCRIPTION

### 5.1 LCM Connector PIN Assignment

	Symbol	Description	Note
1	VCC	Power supply: +3.3V	-
2	VCC	Power supply: +3.3V	-
3	NC	No Connection	(4)
4	LR/UD	Reverser Scan Control H or NC= Normal Mode L= Horizontal/Vertical Reverse Scan	(5)
5	RX0-	LVDS Differential Data Input (Negative)	-
6	RX0+	LVDS Differential Data Input (Positive)	-
7	GND	Ground	
8	RX1-	LVDS Differential Data Input (Negative)	
9	RX1+	LVDS Differential Data Input (Positive)	-
10	NC	No Connection	(4)
11	RX2-	LVDS Differential Data Input (Negative)	
12	RX2+	LVDS Differential Data Input (Positive)	-
13	GND	Ground	-
14	RXCLK-	LVDS Differential Clock (Negative)	-
15	RXCLK+	LVDS Differential Clock (Positive)	-
16	GND	Ground	-
17	RX3-	LVDS Differential Data Input (Negative)	-
18	RX3+	LVDS Differential Data Input (Positive)	-
19	NC	No Connection	(4)
20	SEL68	LVDS 6/8 bit select function control, High-> 6bit input mode Low or NC-> 8bit input mode	( 3 )

Note (1) Connector Part No.: Cvilux CID520D1HR0-NH or equivalent.

Note (2) User's connector Part No.: Hirose DF14-20S-1.25C or equivalent.

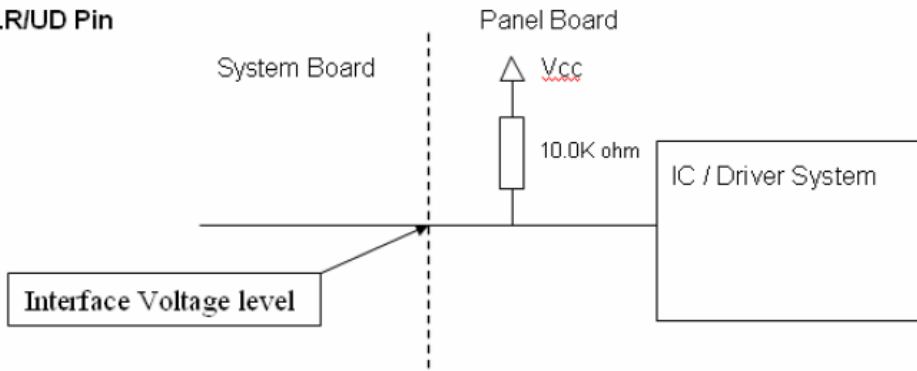
Note (3) "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connection"

Note (4) Pin3, Pin10, Pin19 input signals should be set to no connection or ground, this module would operate normally.

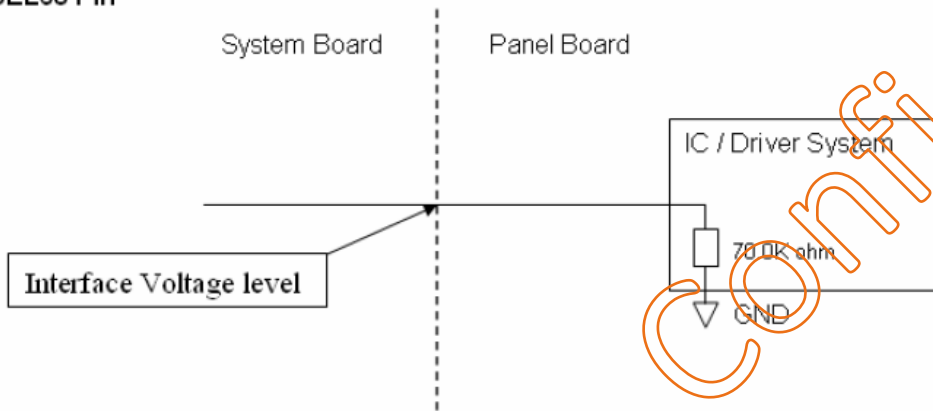
Note (5) Normal scan (pin 4, LR/UD = High or NC)

Reverse scan (pin 4, LR/UD = Low)

LR/UD Pin



SEL68 Pin



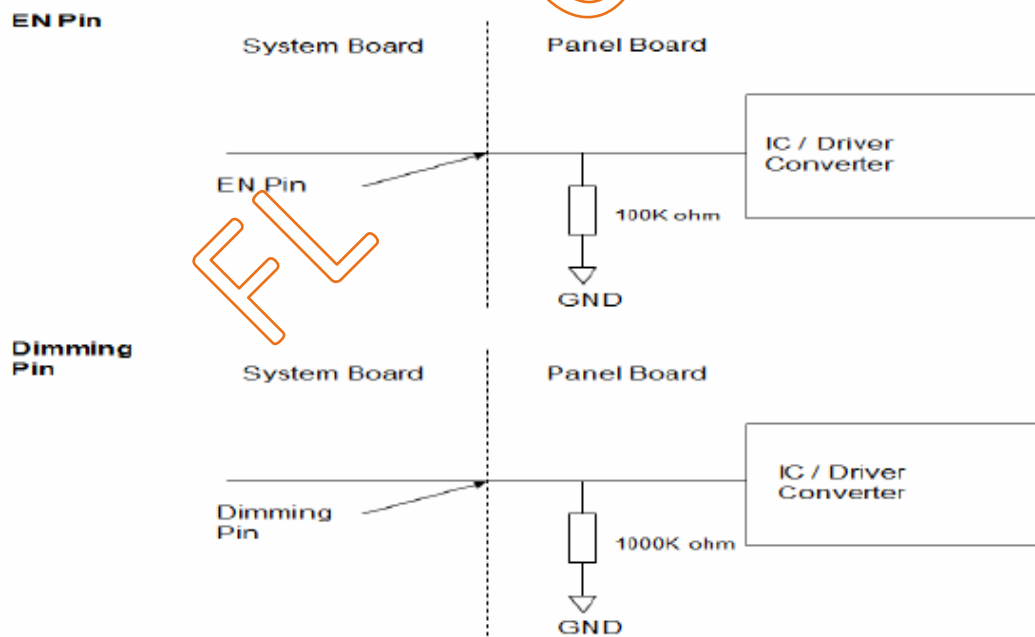
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## 5.2 Backlight and LED Driver Connector PIN Assignment

Pin No	Symbol	Description	Remark
1	Vi	Converter input voltage	12V
2	VGND	Converter ground	Ground
3	EN	Enable pin	3.3V
4	Dimming	Backlight Adjust	PWM Dimming (Hi: 3.3V <sub>DC</sub> , Lo: 0V <sub>DC</sub> )
5	NC	Not Connect	

Note (1) Connector Part No.: CI4205M2HRP-NH(Cvilux) or equivalent.

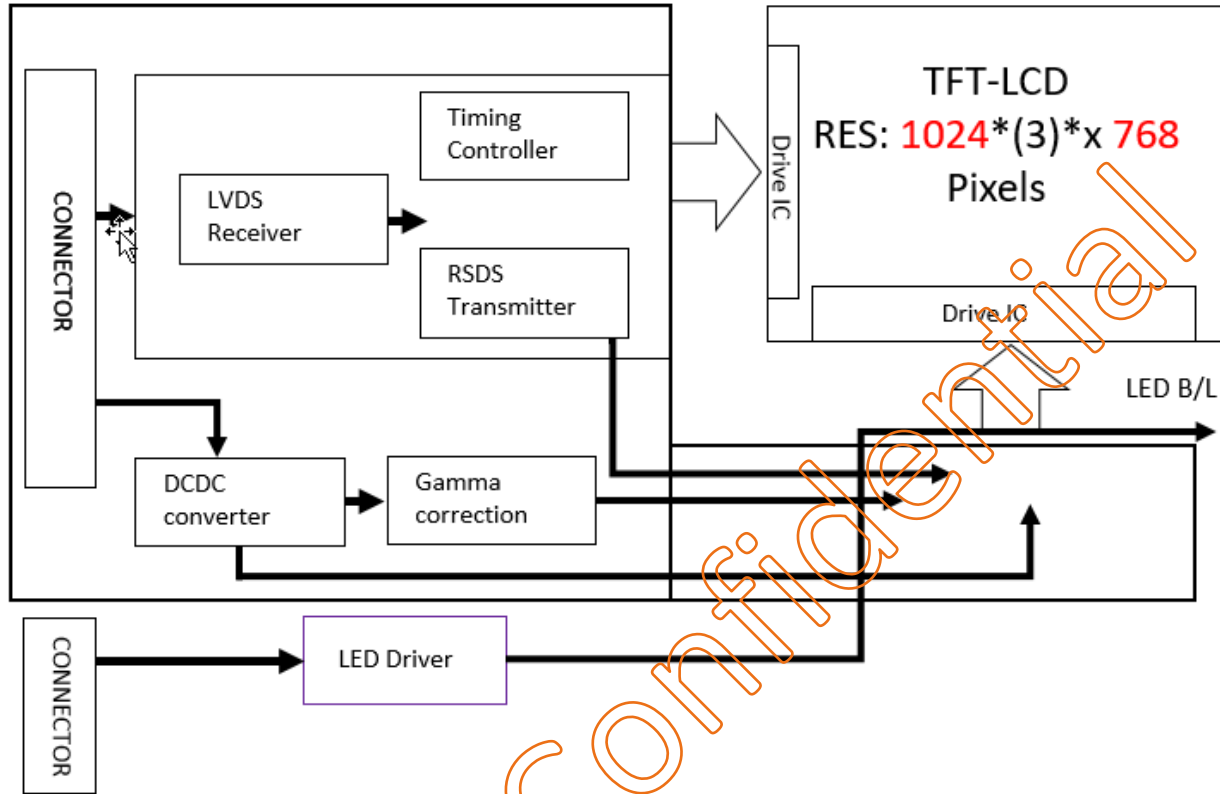
Note (2) User's connector Part No.: CI4205SL000(Cvilux) or equivalent.





## 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.

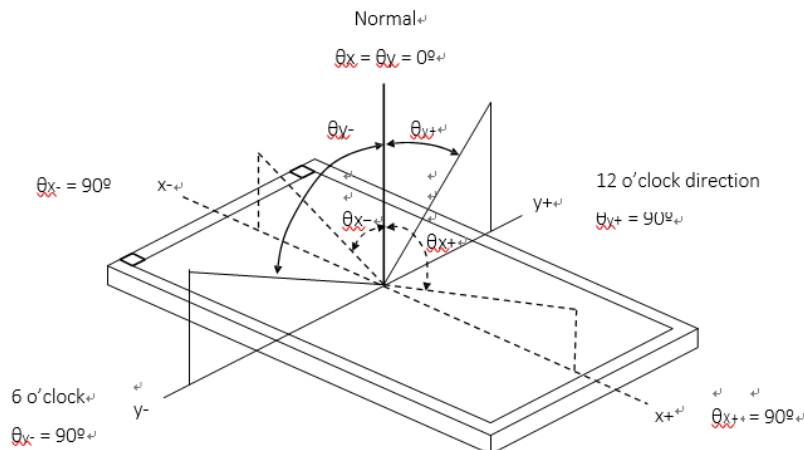
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing angle at normal direction	1800	2500	-	-	(2)(5)
Response Time		$T_R$		-	16	21	ms	(3)
		$T_F$		-	7	14	ms	
Center Luminance of White		$L_C$		400	500	-	cd/m <sup>2</sup>	(4)(5)
White Variation		$\delta W$		-	1.25	1.33	-	(5)(6)
Chromaticity	Red	$R_x$		CR $\geq$ 10	Typ.	0.647	Typ.	-
		$R_y$	0.338			-		
	Green	$G_x$	0.321			-		
		$G_y$	0.606			-		
	Blue	$B_x$	0.157			-		
		$B_y$	0.039			+0.05		-
	White	$W_x$	0.313			-		
		$W_y$	0.329			-		
Viewing Angle	Horizontal	$\theta_{x+}$	80	88	-	Deg.	(1)(5)	
		$\theta_{x-}$	80	88	-			
	Vertical	$\theta_{y+}$	80	88	-			
		$\theta_{y-}$	80	88	-			

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

The room temperature is 25°C $\pm$ 2°C

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

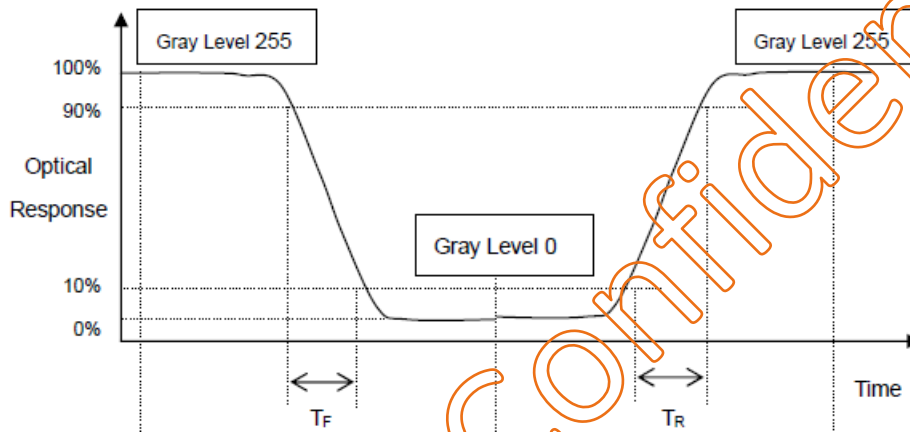


Note 2: Definition of Contrast Ratio (CR)

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:

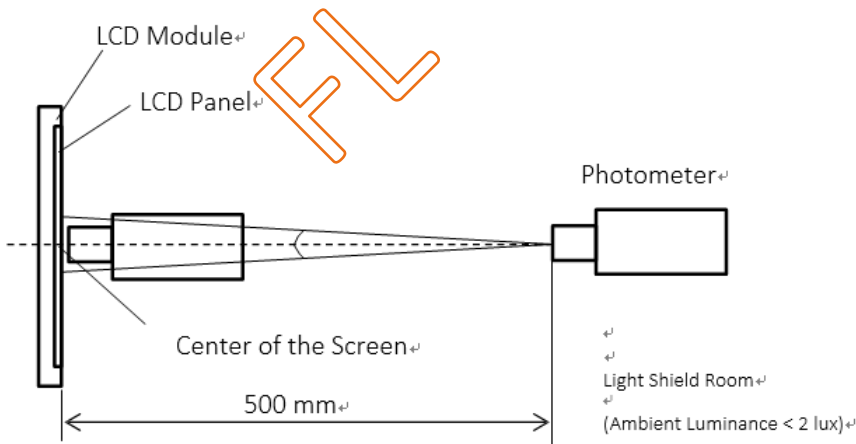
The response time is set initially by defining the “Rising Time ( $T_r$ )” and the “Falling Time ( $T_f$ )” respectively. The response time interval is between 10% and 90% of amplitudes, please refer the figure to the followings:



Note 4: Definition of Brightness (Lc)

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

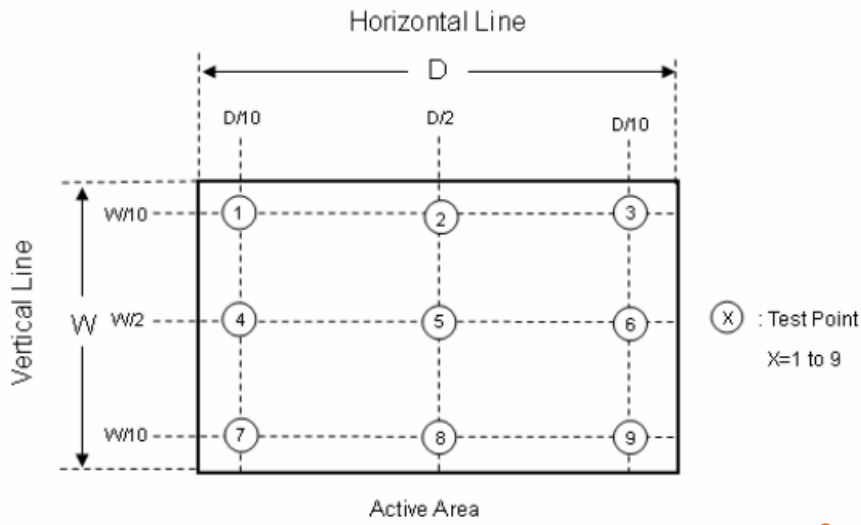
Note 5: The method of optical measurement:



Note 6: Definition of White Variation ( $\delta W$ ):

Measure the luminance of gray level 255 at 9 points

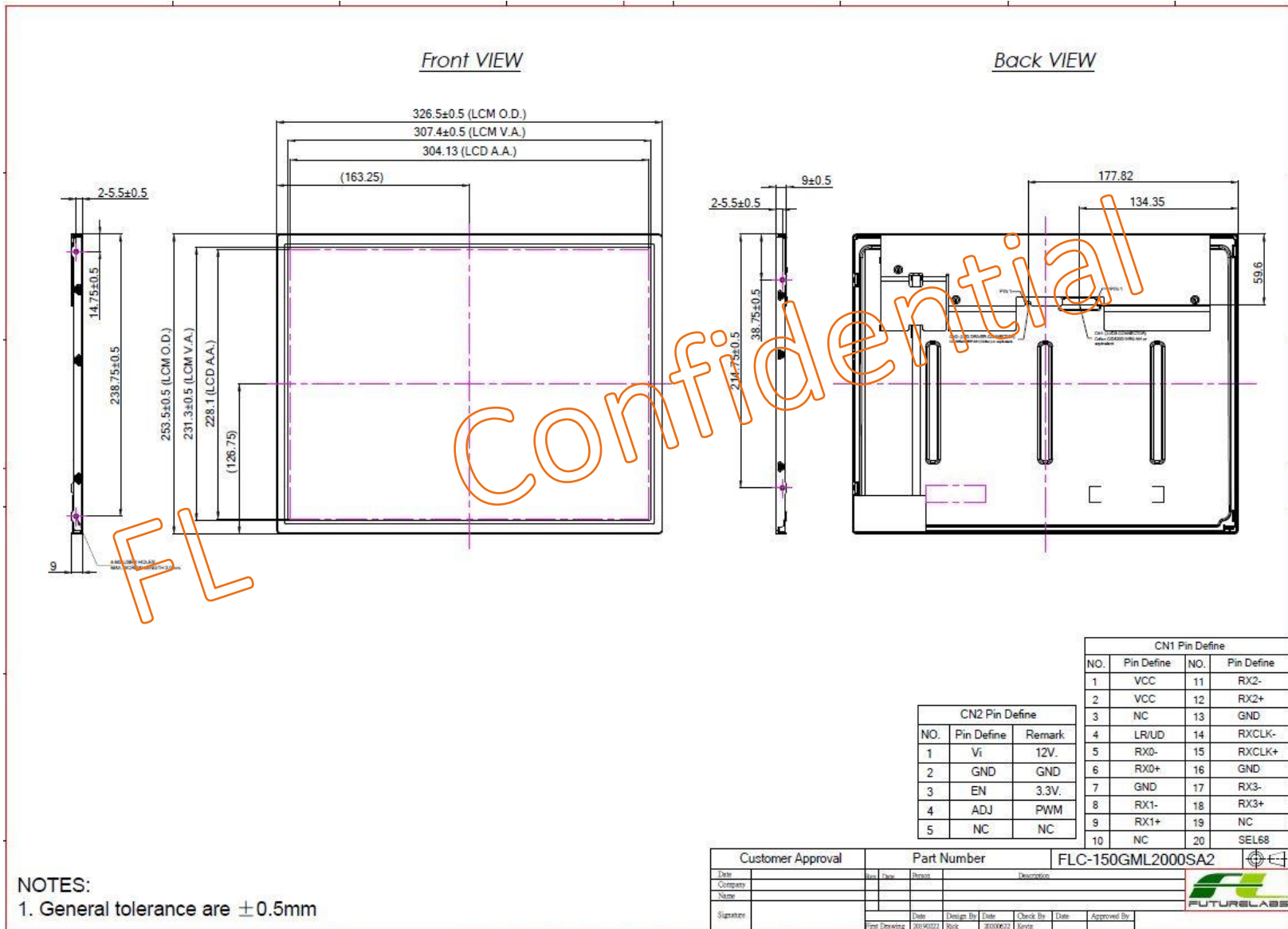
$$\delta W = \text{Maximum [L (1), L (2), L (3)...L (8), L (9)] / Minimum [L (1), L (2), L (3)... L (4), L (5)]}$$



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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.