

## Product Specification

PART NUMBER # REV: FLC-090DMLH000SA1#00

DESCRIPTION: TFT 9", 800(H)\*480(V), LVDS,  
16.7M colors, 1000CD

- Preliminary Specification
- Approved Specification

<b>Customer Name:</b>	
<b>Signature:</b>	<b>Date:</b>

PREPARED BY	REVIEWED BY
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## Revision History

Version	Date	Page	Description	Note
V1.0	2021/03/10		1st initial	
V1.1	2021/3/25		Add Reliability Test	

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# 1. GENERAL DESCRIPTION

## 1.1 Description

9 inch 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 800 x 480 screen and 16.7 M 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	9	Inch
2	Pixel Number	800 (H) x 3(RGB)x 480 (V)	Pixels
3	Outline Dimension	218.0(W) x 135.0(H) x 11.15 (D)	mm
4	Active Area	196.8(W) x 118.08(H)	mm
5	Pixel Pitch	0.246(H) x 0.246(V)	mm
6	Display Colors	16.7M colors	
7	Pixel Arrangement	RGB Vertical stripe	--
8	Display Mode	Transmissive Color TFT, Normally Black	--
9	Electrical Interface	LVDS; 20 pins	--
10	Brightness	1000 (Typ.)	cd/m2
11	Contrast Ratio	1000 (Typ.)	--
12	Power Consumption	1.2W for LCD 4.8W for Backlight	W

## 2. ABSOLUTE MAXIMUM RATING

### 2.1 Electrical Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max		
Power supply voltage	V <sub>DD</sub>	-0.3	-	4.0	V	
Input Voltage of Logic	V <sub>I</sub>	-0.3	-	V <sub>DD</sub> +0.3	V	Note 1
Backlight Input Voltage	V <sub>LED</sub>	-	-	15	V	

### 2.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Operating Temperature	Top	-40	-	+85	°C	Note 2
Storage Temperature	Tstg	-40	-	+90	°C	

Note 1: The rating is defined for the signal voltages of the interface such as DIM, SD, AMODE, CLK and pixel 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:

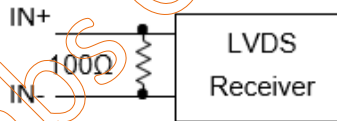
- Background color, contrast and response time would be different in temperatures other than 25 °C.
- Operating under high temperature will shorten LED lifetime.

### 3. ELECTRICAL CHARACTERISTICS

#### 3.1 LCD Electrical Specification

Item	Symbol	Condition	Min.	Type	Max.	Unit.	Note
Power supply voltage	$V_{DD}$	-	3.0	3.3	3.6	V	-
Input Voltage of Logic	$V_I$	"H" level	-	-	+100	mV	Note 1
		"L" level	-100	-	-		
Signal Input Voltage	$V_I$	"H" level	$0.7V_{DD}$	-	$V_{DD}$	V	CMOS Level
		"L" level	0	-	$0.3V_{DD}$		
Power Supply Current	$I_{DD}$	$V_{DD}-V_{SS}=3.3V$	330	370	430	mA	Note 2,3
Frame Frequency	$f_{Frame}$			60	75	Hz	
DCLK Frequency	$f_{CLK}$	-	-	33.3	35	MHz	

Note 1: VCM 1.2V is common mode voltage of LVDS transmitter and receiver .The input terminal of LVDS receiver is terminated with 100Ω.



Note 2: An all white check pattern is used when measuring  $I_{DD}$ .  $f_{Frame}$  is set to 60 Hz.

Note 3: 1.0A fuse is applied in the module for  $I_{DD}$ . For display activation and protection purpose, power supply is recommended larger than 2.5A to start the display and break fuse once any short circuit occurred.

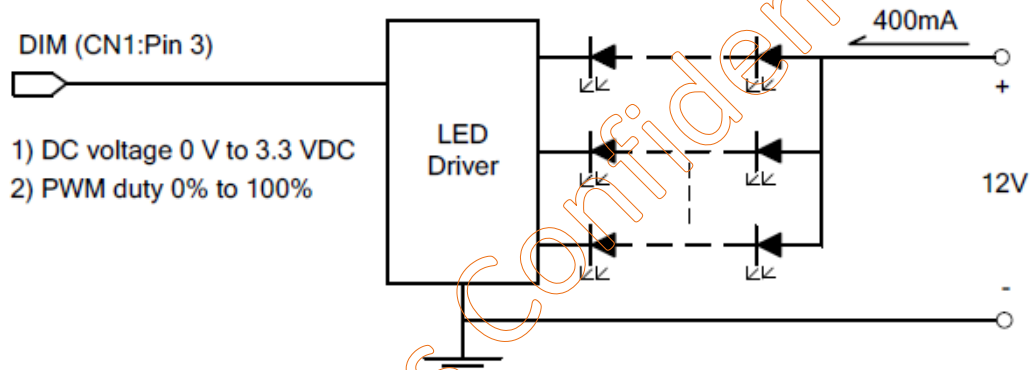
### 3.2 Backlight Unit

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

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
LED Input Voltage	$V_{LED}$	-	11.5	12.0	12.5	V	Note 1
LED Forward Current (Dim control)	$I_{LED}$	0V; 0% duty	360	400	440	mA	
		3.3VDC; 100% Duty	42	45	47		
LED Life Time	$LT_{LED}$	$I_{LED} = 400mA$	-	70K	-	Hrs	Note 2

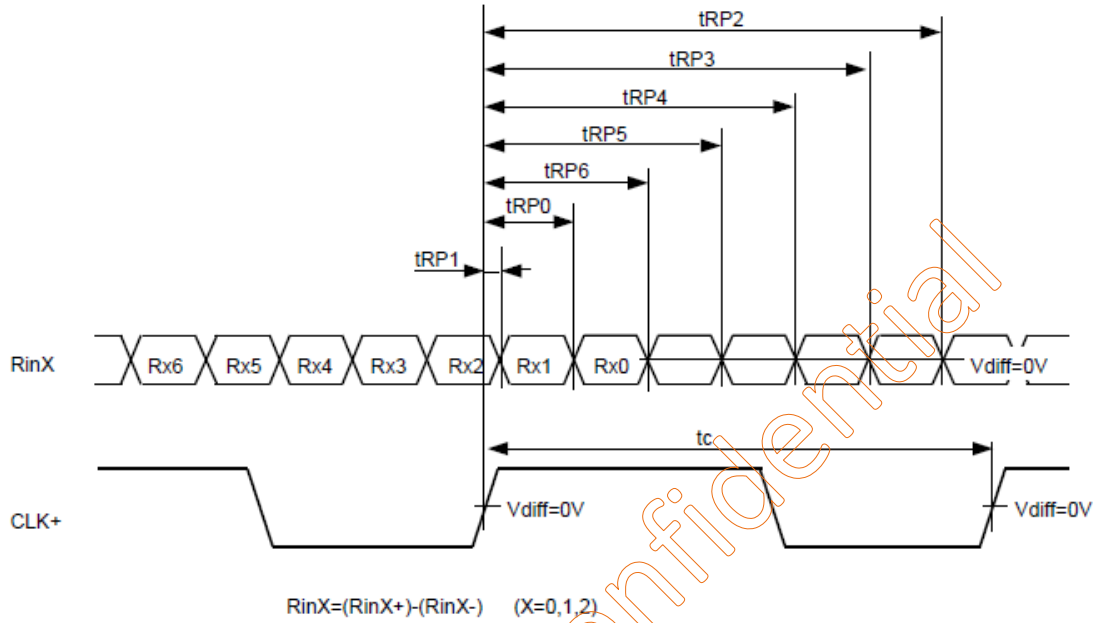
Note 1: As Fig below shown, LED current is constant, 400mA, controlled by the LED driver when applying 12V.

Note 2: The estimated lifetime is specified as the time to reduce 50% brightness by applying 400mA at 25 °C .



## 4. Timing Chart

### 4.1 LVDS Receiver Timing (interface of TFT Module)



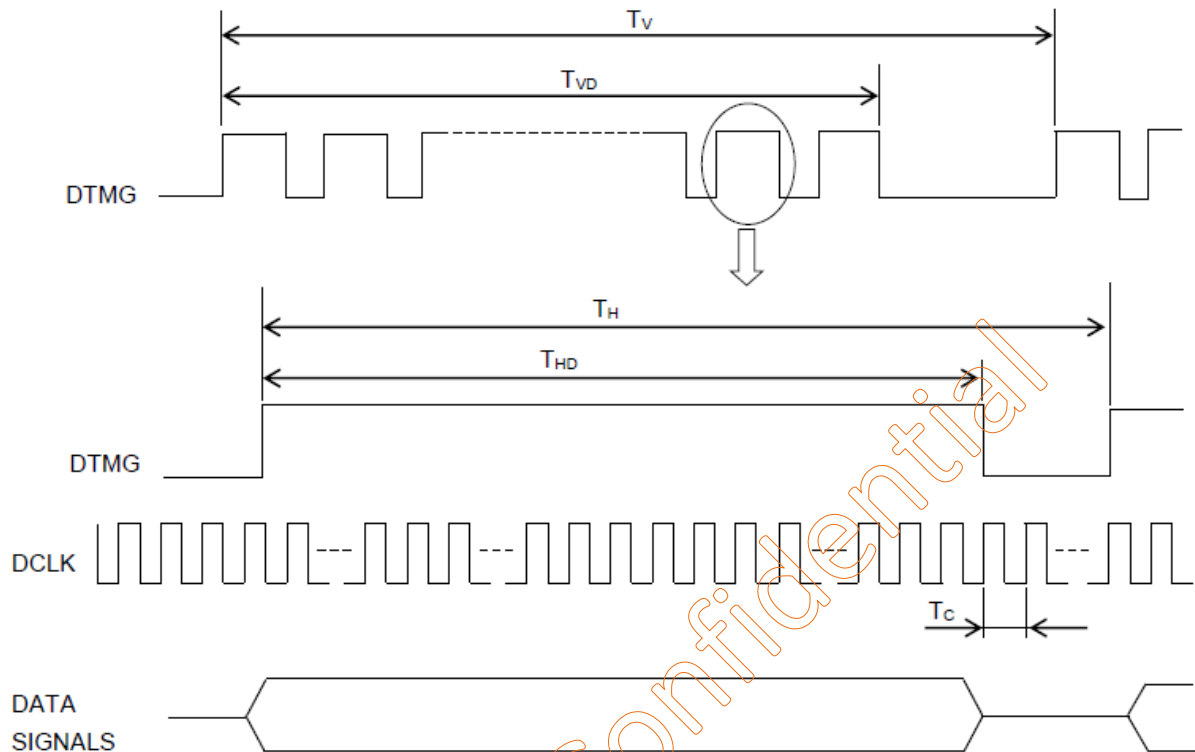
Parameter		Symbol	Min.	Typ.	Max.	Unit
DCLK	Frequency	$1/t_c$	25.0	28.0 (1)   33.3 (2)	35.0	MHz
RinX (X=0, 1, 2)	0 data position	$t_{RP0}$	$1/7t_{CLK}-0.65$	$1/7*t_{CLK}$	$1/7t_{CLK}+0.65$	ns
	1 <sup>st</sup> data position	$t_{RP1}$	-0.65	0	-0.65	
	2 <sup>nd</sup> data position	$t_{RP2}$	$6/7t_{CLK}-0.65$	$6/7*t_{CLK}$	$6/7t_{CLK}+0.65$	
	3 <sup>rd</sup> data position	$t_{RP3}$	$5/7t_{CLK}-0.65$	$5/7*t_{CLK}$	$5/7t_{CLK}+0.65$	
	4 <sup>th</sup> data position	$t_{RP4}$	$4/7t_{CLK}-0.65$	$4/7*t_{CLK}$	$4/7t_{CLK}+0.65$	
	5 <sup>th</sup> data position	$t_{RP5}$	$3/7t_{CLK}-0.65$	$3/7*t_{CLK}$	$3/7t_{CLK}+0.65$	
	6 <sup>th</sup> data position	$t_{RP6}$	$2/7t_{CLK}-0.65$	$2/7*t_{CLK}$	$2/7t_{CLK}+0.65$	

Note 1:  $f_{Frame}=50Hz$

Note 2:  $f_{Frame}=60Hz$



## 4.2 Timing Converter Timing (Input Timing for Transmitter)

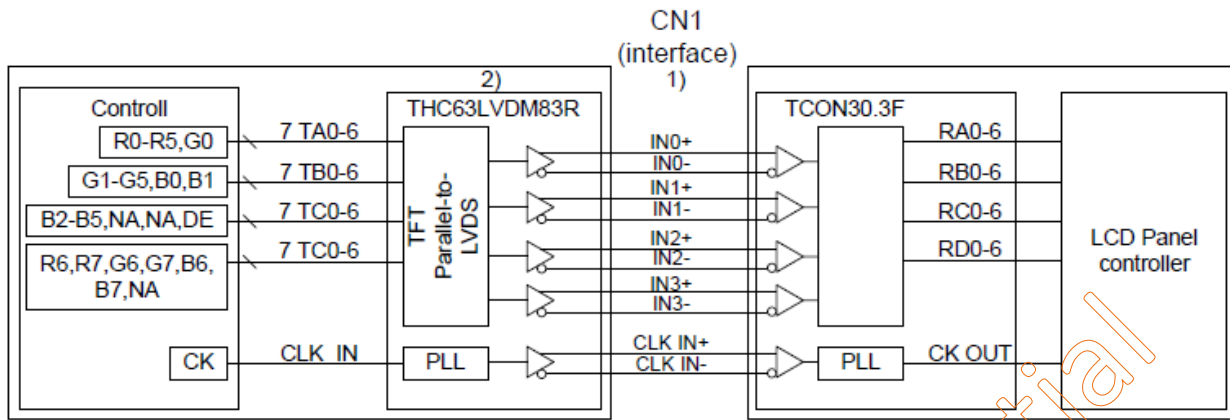


The timings except mentioned above are referred to the specifications of your transmitter.

Parameter		Symbol	Min.	Type	Max.	Unit.
Vertical Section	Period	$T_V$	483	525	640	$T_H$
	Width Active	$T_{VD}$	480			$T_H$
	Frequency	$F_V$	42	60	75	Hz
Horizontal Section	Period	$T_H$	845	1056	1500	$T_C$
	Width Active	$T_{HD}$	800			$T_C$
DCLK	Cycle time	$T_C$	28.6	30.0	40.0	ns
	Duty	$D$	0.45	0.5	0.55	-

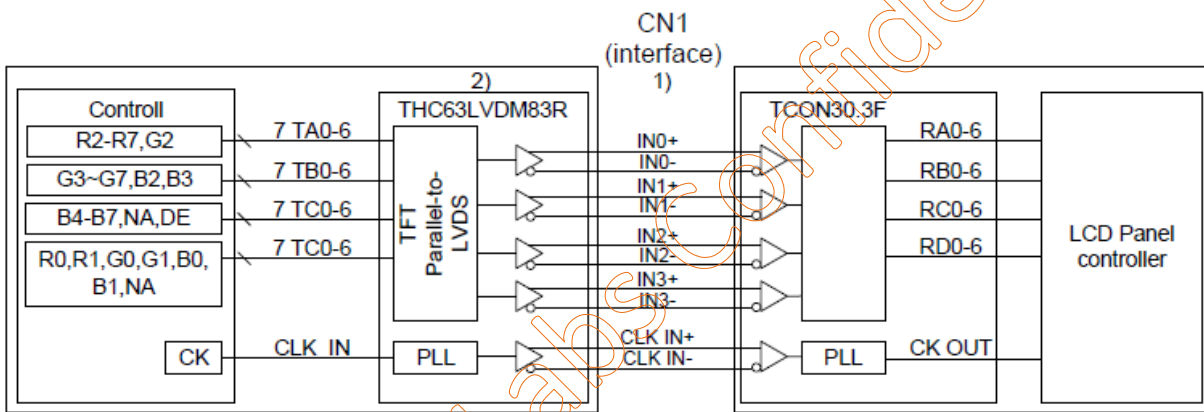
### 4.3 LVDS Data Format

#### 4.3.1 8Bit Mode ( AMODE = LOW )

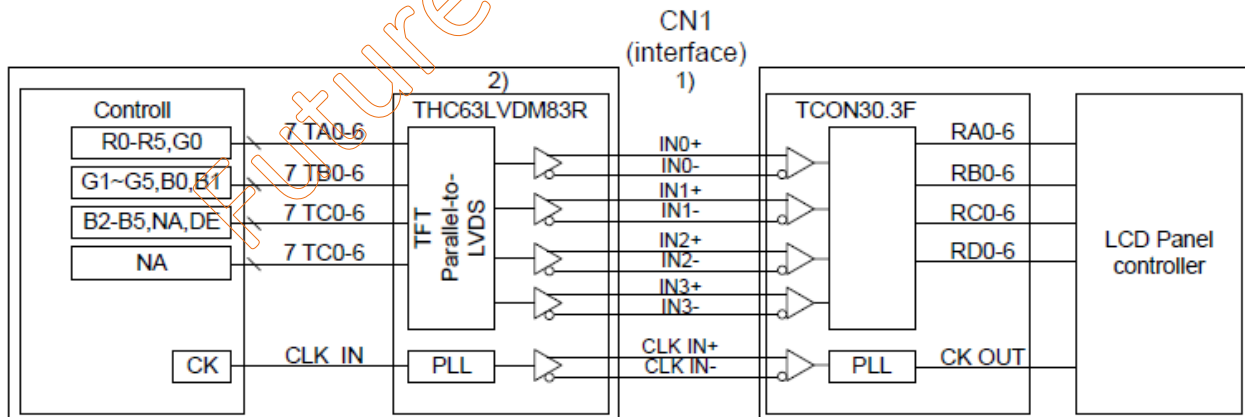


#### 4.3.2 8Bit / 6Bit Mode( AMODE = HIGH )

##### (1) 8Bit Mode



##### (2) 6Bit Mode

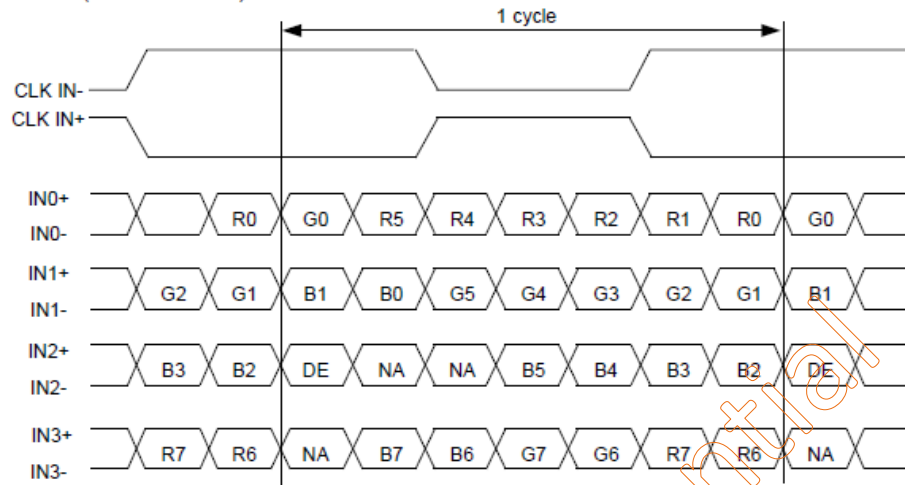


Note 1: 100Ω impedance of LVDS cable is recommended for best optical performance.

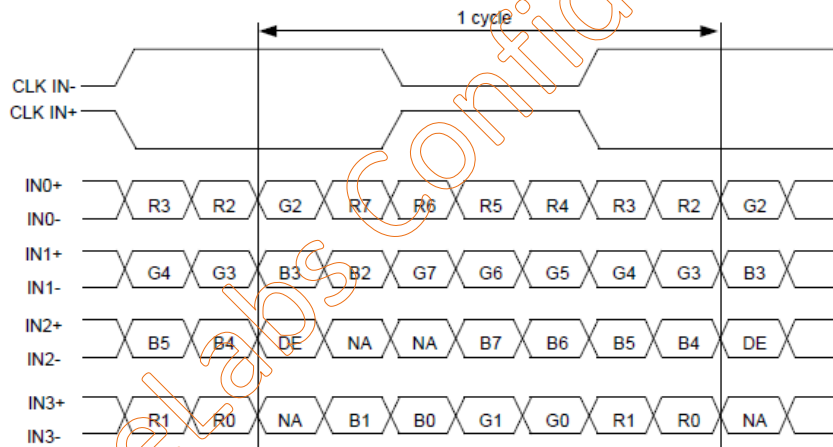
Note 2: Transmitter Made by Thine : THC63LVDM83R or equivalent.

### 4.3.3 Data Mapping

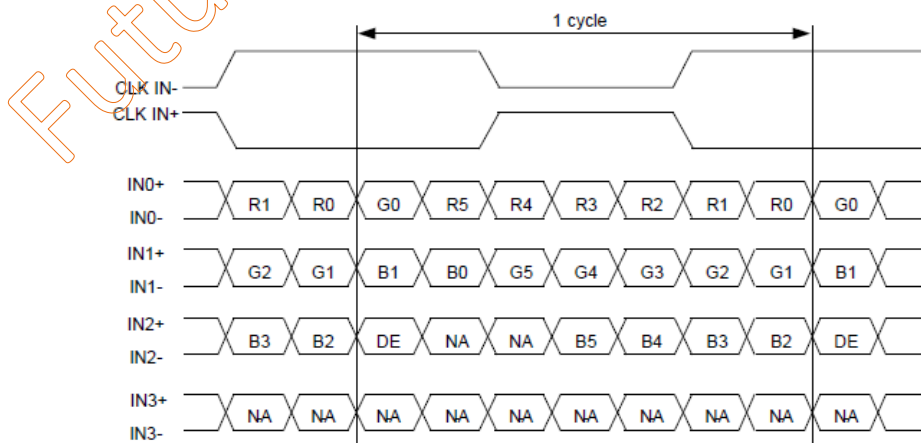
#### (1) 8Bit Mode (Amode=Low)



#### (2) 8Bit Mode (Amode=High)



#### (2) 6Bit Mode (Amode=High)

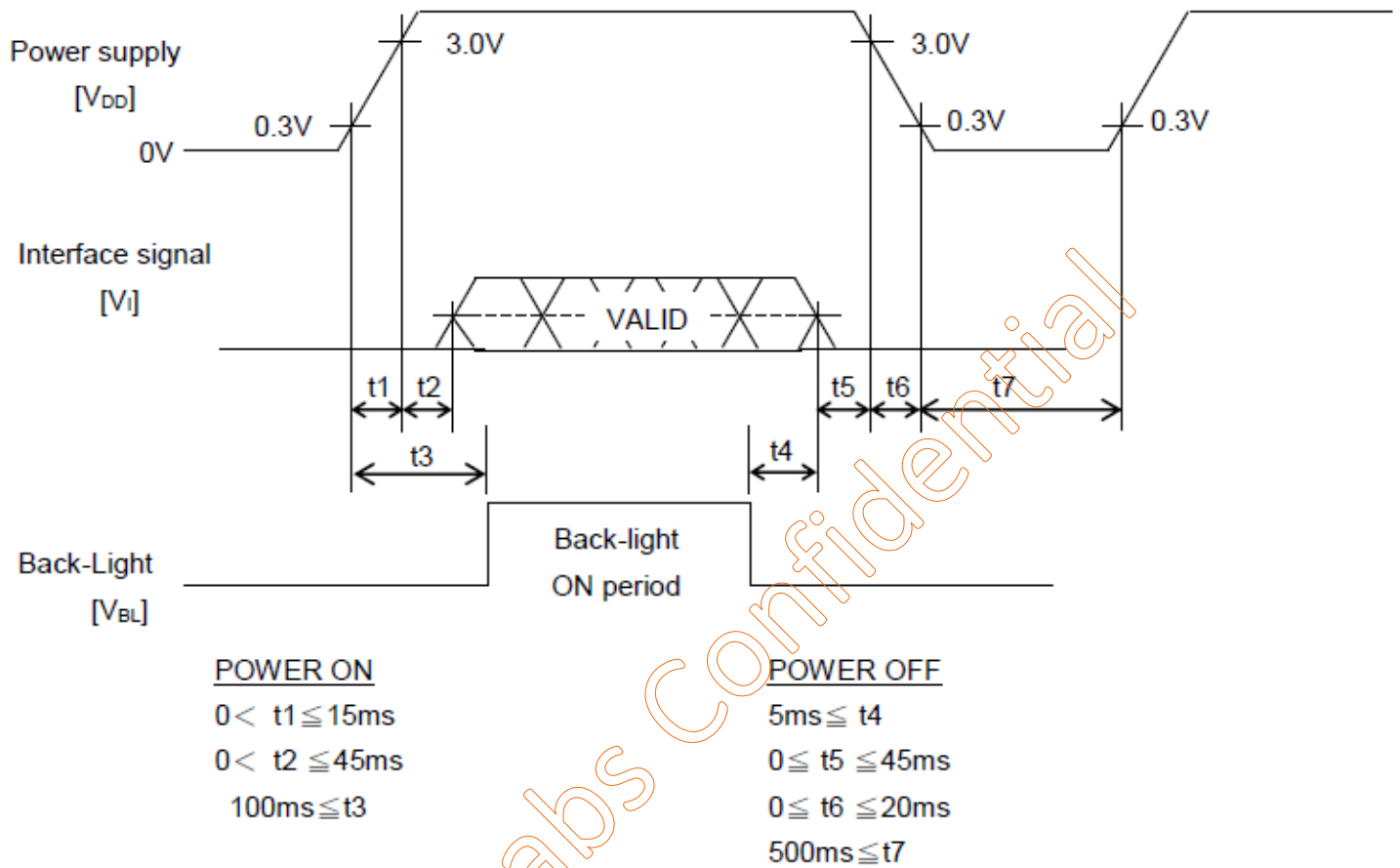


DE: Display Enable      NA: Not Available

Transmitter		8Bit Mode	8Bit Mode	6Bit Mode
Pin No.	Pin name	AMODE		
		LOW	HIGH	
51	TA0	R0(LSB)	R2	R0(LSB)
52	TA1	R1	R3	R1
54	TA2	R2	R4	R2
55	TA3	R3	R5	R3
56	TA4	R4	R6	R4
3	TA5	R5	R7(MSB)	R5(MSB)
4	TA6	G0(LSB)	G2	G0(LSB)
6	TB0	G1	G3	G1
7	TB1	G2	G4	G2
11	TB2	G3	G5	G3
12	TB3	G4	G6	G4
14	TB4	G5	G7(MSB)	G5(MSB)
15	TB5	B0(LSB)	B2	B0(LSB)
19	TB6	B1	B3	B1
20	TC0	B2	B4	B2
22	TC1	B3	B5	B3
23	TC2	B4	B6	B4
24	TC3	B5	B7(MSB)	B5(MSB)
27	TC4	(NA)	(NA)	(NA)
28	TC5	(NA)	(NA)	(NA)
30	TC6	DE	DE	DE
50	TD0	R6	R0(LSB)	(NA)
2	TD1	R7(MSB)	R1	(NA)
8	TD2	G6	G0(LSB)	(NA)
10	TD3	G7(MSB)	G1	(NA)
16	TD4	B6	B0(LSB)	(NA)
18	TD5	B7(MSB)	B1	(NA)
25	TD6	(NA)	(NA)	(NA)

#### 4.4 Power On/Off Sequence

Power Supply, Input Signal and Backlight Voltage should comply with the following sequence.



Note 1: In order to prevent electronic parts from destruction caused by latch-up, please input signal after power supply voltage on. in addition, please turn off signals before power supply voltage off.

Note 2: In order to prevent from function error due to residual charge, please reenter power supply voltage after time stipulated with t7.

Note 3: Please turn on backlight after signals fix and turn off before signals down, otherwise noise appears in the display. The noise cause no problem with display performance in case of timing sequence comply with the spec.

## 5. INTERFACE PIN DESCRIPTION

### 5.1 LCM Connector PIN Assignment

The electronics interface connector is JAE FI-SEB20P-HF13E or equivalent.

Pin No.	Signal	Signal	Pin No.	Signal	Signal
1	V <sub>DD</sub>	Power Supply (typ.+3.3V)	11	IN2-	Pixel Data
2	V <sub>DD</sub>		12	IN2+	
3	DIM	Backlight diming (Note 3)	13	V <sub>SS</sub>	GND
4	V <sub>SS</sub>	GND	14	CLK IN-	Pixel Clock
5	INO-	Pixel Data	15	CLK IN+	
6	INO+		16	V <sub>SS</sub>	GND
7	V <sub>SS</sub>	GND	17	IN3-	Pixel Data
8	IN1-	Pixel Data	18	IN3+	
9	IN1+		19	SD	Scan Direction Control (Note 1)
10	V <sub>SS</sub>	GND	20	AMODE	L:8bit(default),H:8bit/6bit

Note 1: Scan direction is available to be switched as below.



SD: Low or Open (Default)



SD: High

Note 2: In n- and n+ (n=0,1,2,3), CLK IN- and CLK IN+ should be wired by twist-pairs or side by side FPC patterns, respectively.

Note 3: Normal brightness: 0V or 0% PWM duty; Brightness control: 0V to 3.3V DC or 0% to 100% PWM duty.

## 5.2 Backlight Interface PIN Assignment

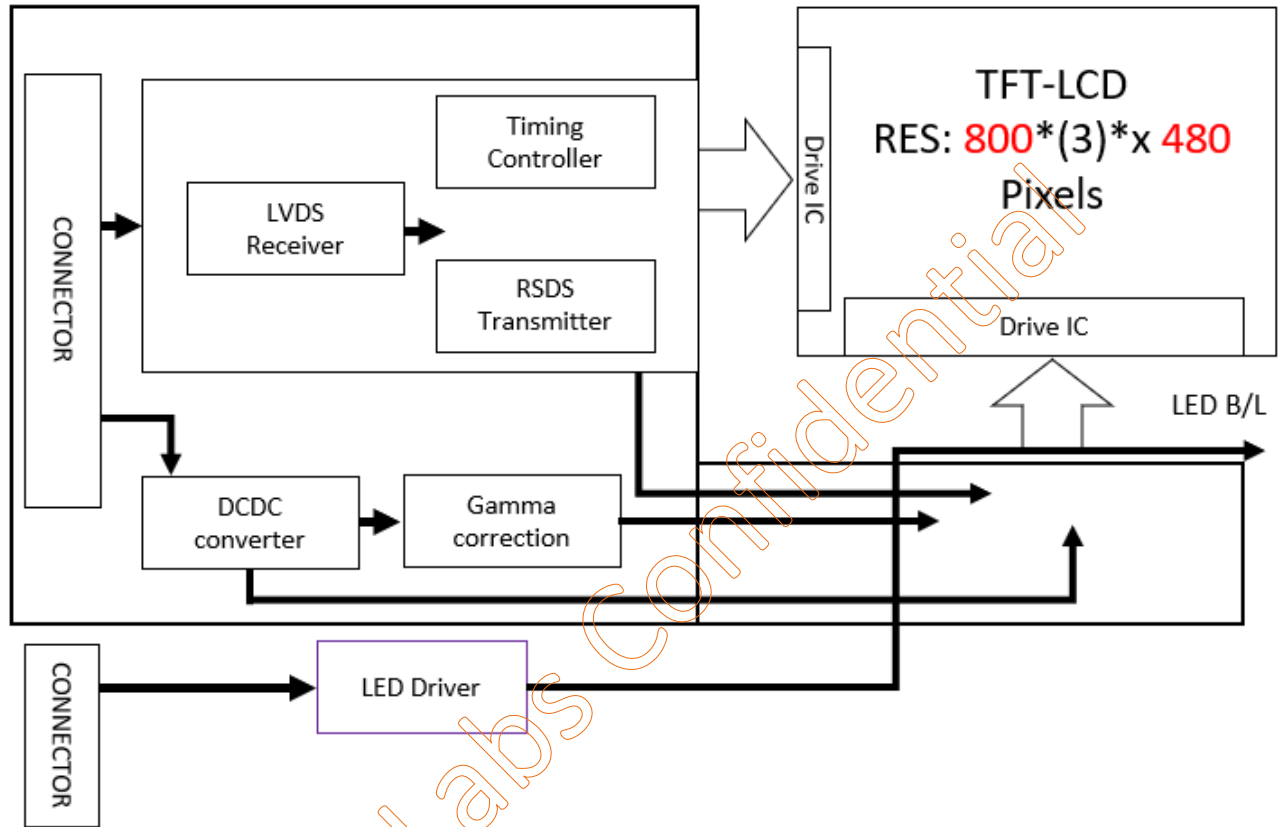
The electronics interface connector is JSTEM08B-SRSS-TB or equivalent.

Pin No.	Signal	Function
1~3	V <sub>LED+</sub>	Power Supply for LED (12V)
4~5	NC	No Connection
6~8	V <sub>LED-</sub>	GND

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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.

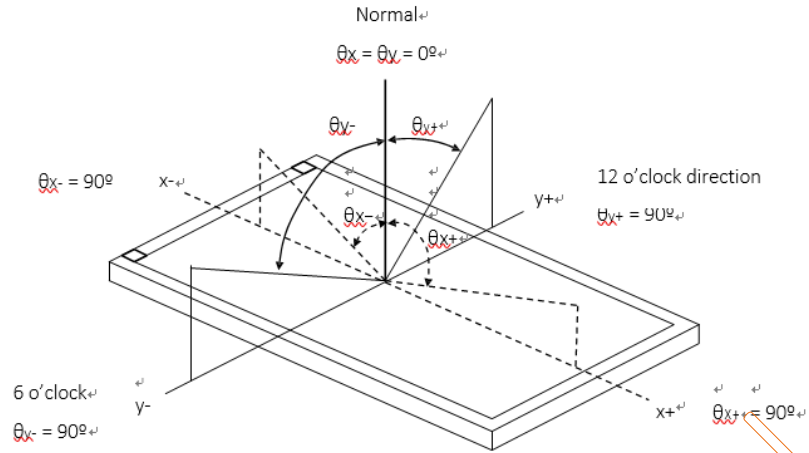
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast Ratio		CR	$\theta_x=0^\circ$	700	1000	-	-	(2)(5)	
Response Time		T <sub>R</sub>	25°C	-	40	-	ms	(3)	
		T <sub>F</sub>							
Center Luminance of White		LC	$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing angle at normal direction	800	1000	-	cd/m <sup>2</sup>	(4)(5)	
Brightness uniformity				75	-	-	%	(5)(6)	
NTSC Ratio		-		-	72	-	%	-	
Chromaticity	Red	R <sub>x</sub>		$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing angle at normal direction	Typ. -0.05	0.64	Typ. +0.05	-	(1) (5)
		R <sub>y</sub>				0.35		-	
	Green	G <sub>x</sub>	0.32			-			
		G <sub>y</sub>	0.62			-			
	Blue	B <sub>x</sub>	0.14			-			
		B <sub>y</sub>	0.06			-			
	White	W <sub>x</sub>	0.30			-			
		W <sub>y</sub>	0.32			-			
Viewing Angle	Horizontal	$\theta_{x+}$	CR=10	-	85	-	Deg.	(1)(5)	
		$\theta_{x-}$		-	85	-			
	Vertical	$\theta_{y+}$		-	85	-			
		$\theta_{y-}$		-	85	-			

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±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

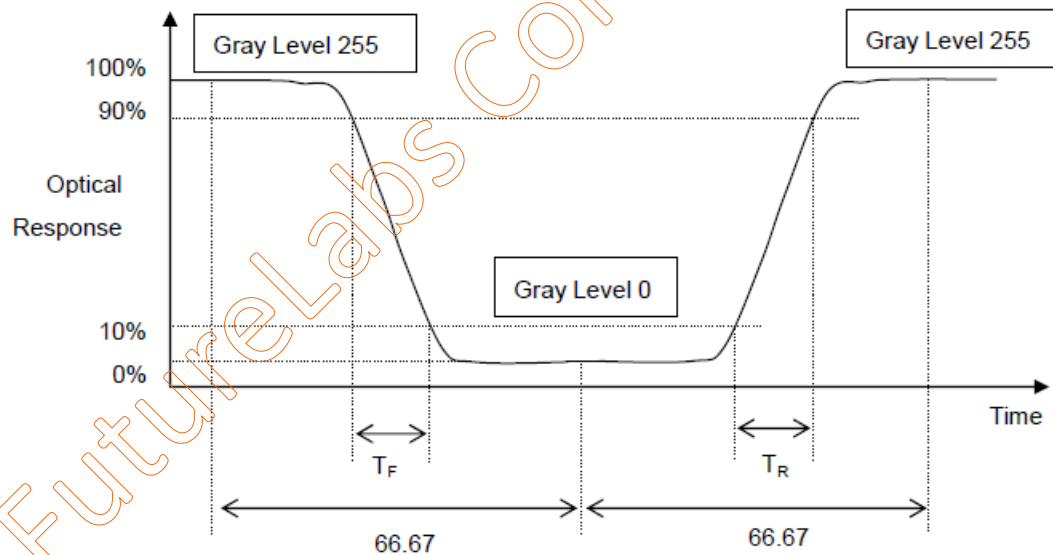


Note 2: Definition of Contrast Ratio (CR)

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:

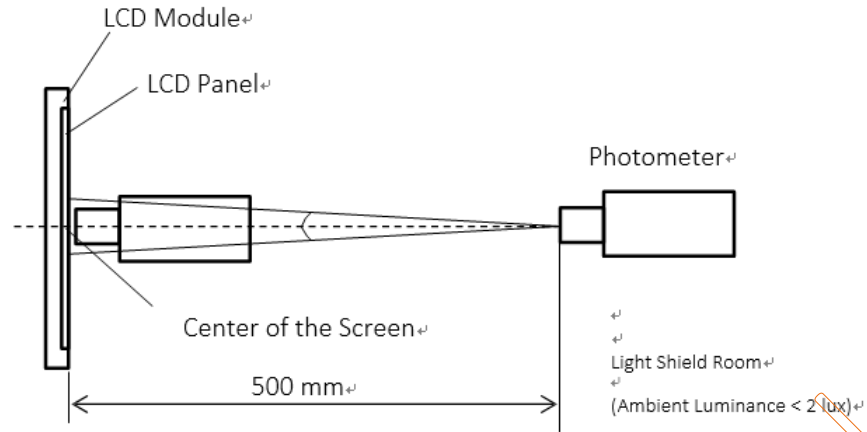
The response time is set initially by defining the "Rising Time (TR)" and the "Falling Time (TF)" respectively. Please refer the figure to the followings:



Note 4: Definition of Brightness (L)

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

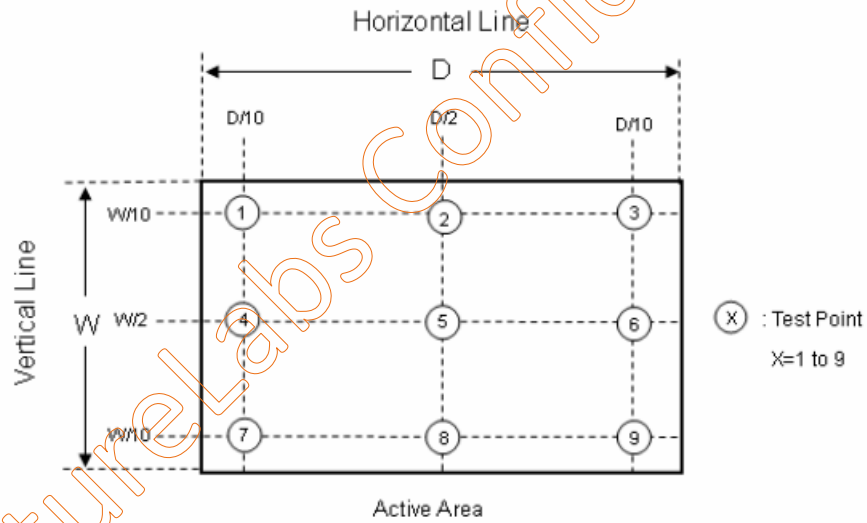
Note 5: The method of optical measurement:



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

Measure the luminance of gray level 255 at 5 points

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

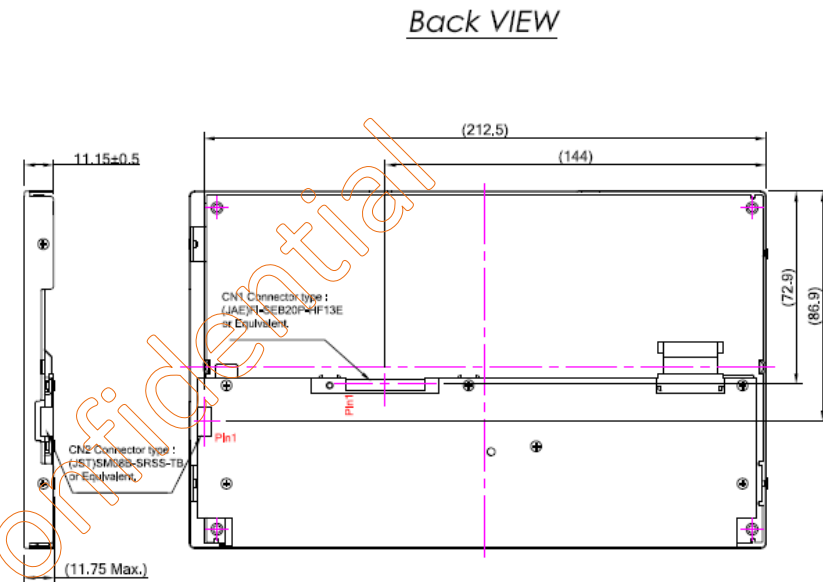
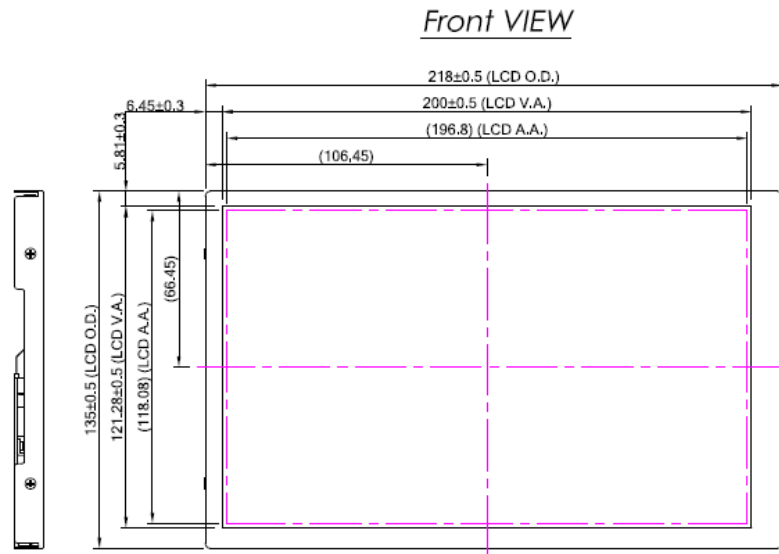


## 8. Reliability Test

Test Item	Operating Mode	Temperature / Humidity	Condition
High Temperature	Operating	85°C	500 hrs
Low Temperature	Operating	-40°C	500 hrs
High Temperature	Storage	90°C	500 hrs
Low Temperature	Storage	-40°C	500 hrs
Thermal Shock	Non- Operating	-35°C ~ 85°C	(1) 0.5 hr $\leftrightarrow$ 0.5 hr (2) 500 hrs
High Temperature & Humidity	Operating	40°C & 85%RH	(1) Without Condensation (2) 500 hrs
Vibration	Non- Operating	Room Temperature	(1) 5G (2) 10~200Hz (3) X, Y and Z directions (4) 1 hr for each direction

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# 9. DIMENSION AND DRAWING



CN2 pin define			
pin	symbol	pin	symbol
1	VDD	11	IN2-
2	VDD	12	IN2+
3	DIM	13	VSS
4	VSS	14	CLKIN-
5	IN0-	15	CLKIN+
6	IN0+	16	VSS
7	VSS	17	IN3-
8	IN1-	18	IN3+
9	IN1+	19	SD
10	VSS	20	AMODE

CN1 pin define	
PIN NO.	SYMBOL
1	VLED+ (12VDC)
2	VLED+ (12VDC)
3	VLED+ (12VDC)
4	NC
5	NC
6	VLED-
7	VLED-
8	VLED-

NOTE:  
1. General Tolerance Is  $\pm 0.5$

Customer Approval		Part Number #Rev		FLC-090DMLH000SA1		#00	
Date	Drawn	Date	Drawn	Description			
Name							
Signature							
	Date	Drawn By	Date	Check By	Date	Approved By	
	2021/02/23						

## 10. 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.