Product Specification

PART NUMBER # REV: FLC-156MML2200001#00

DESCRIPTION: TFT 15.6”W, 1920(H)*1080(V), LVDS, 16.7M Color, 350CD

( ) Preliminary Specification
(V) Approved Specification

Customer Name:	
Signature:	**Date:**

PREPARED BY	**REVIEWED BY**
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Revision History

Version	Date	Page	Description	Note
V1.0	2022/06/27		First Edition	

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1. GENERAL DESCRIPTION

1.1 Description

15.6 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 1920 x 1080 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	15.6”w	Inch
2	Pixel Number	1920 (H) x 3(RGB)x 1080 (V)	Pixels
3	Outline Dimension	363.8(W)×215.9(H)×9.3(D)	mm
4	Active Area	344.16 (W) x 193.59 (H)	mm
5	Pixel Pitch	0.17925 (W) x 0.17925 (H)	mm
6	Display Colors	16.7M colors	
7	Pixel Arrangement	RGB vertical stripe	-
8	Display Mode	Normally Black	-
9	Electrical Interface	2ch-LVDS	-
10	Surface Treatment	Anti-glare	-
11	Brightness	350 (Typ.)	cd/m2
12	Contrast Ratio	800 (Typ.)	-
13	Power Supply Voltage	5.0V for LCD – 12V for Backlight	
14	Power Consumption	Backlight System: 7.8W (Typ.) Total: 11W (Typ.)	W

2. ABSOLUTE MAXIMUM RATING

2.1 Electrical Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max		
Power Supply Voltage	V_{CC}	-0.3	-	5.5	V	(1)
Power Supply Voltage	V_{IN}	-0.3	-	4.0	V	

2.2 Backlight Converter

Item	Symbol	Values			Unit	Note
		Min	Typ	Max		
Converter Voltage	VI	-0.3	-	18	V	(1),(2)
Enable Voltage	EN	-	-	5.5	V	
Backlight Adjust	Dimming	-	-	5.5	V	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for LED (Refer to 3.2 for further information).

2.3 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Operating Temperature	Top	-20	-	+70	°C	(1),(2)
Storage Temperature	T_{ST}	-30	-	+70	°C	

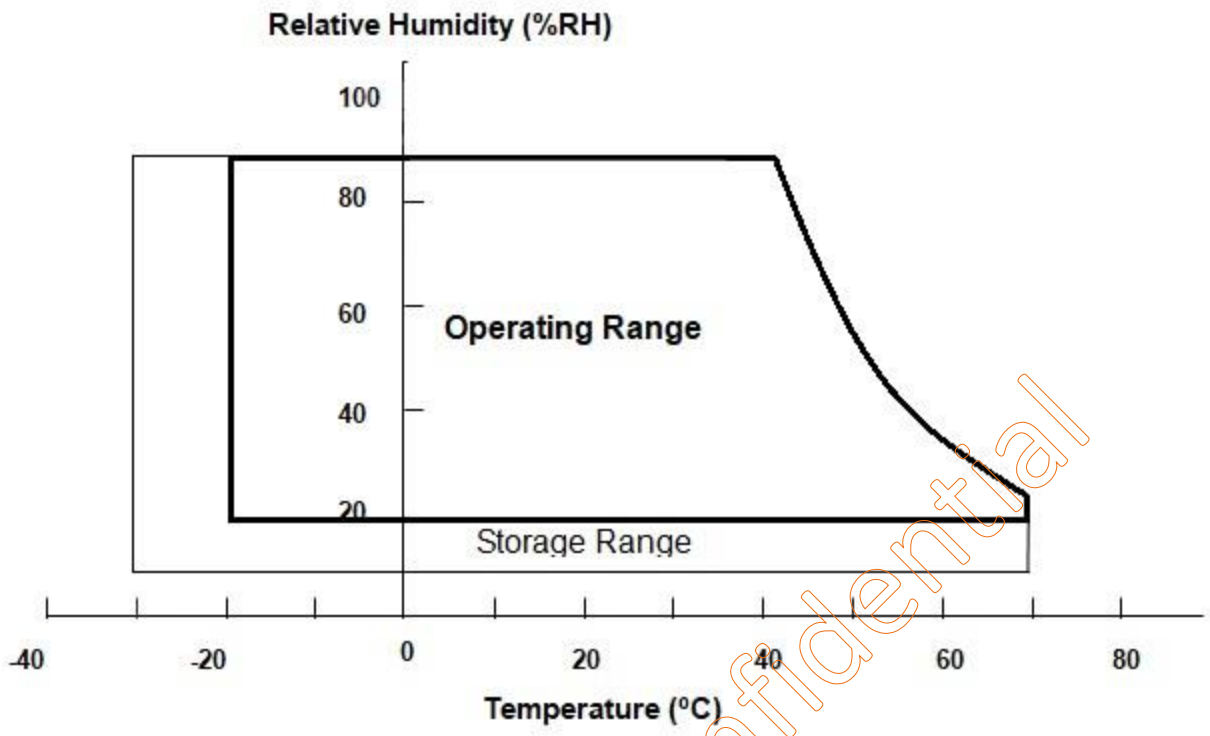
Note (1)

(a) 90 %RH Max.

(b) Wet-bulb temperature should be 39 ºC Max.

(c) No condensation.

Note (2) Panel surface temperature should be 0 ºC min. and 65 ºC max under Vcc=5.0V, fr =60Hz, typical LED string current, 25 ºC ambient temperature, and no humidity control . Any condition of ambient operating temperature, the surface of active area should be keeping not higher than 70 ºC.



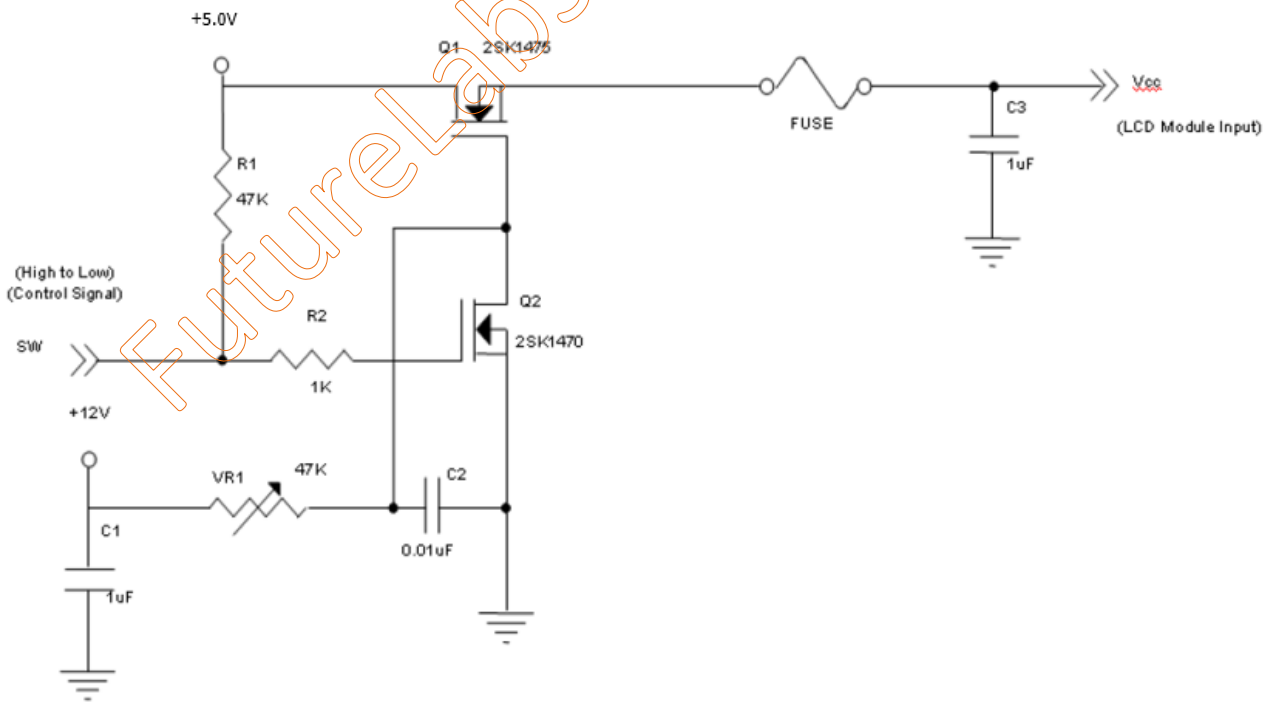
3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD Module

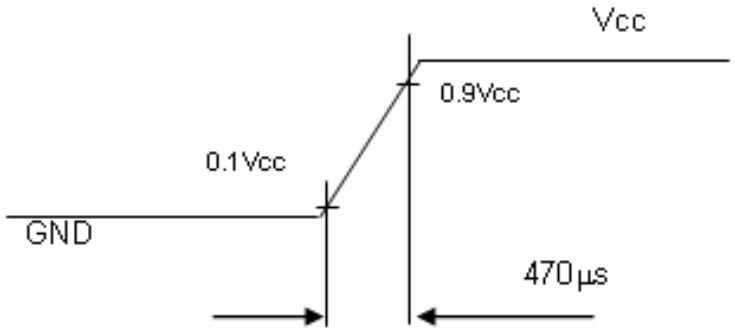
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	4.5	5	5.5	V	-
Ripple Voltage		V_{RP}	-	-	200	mVp-p	
Inrush Current		I_{INRUSH}	-	-	3.0	A	(2)
Power Supply Current	White	Icc	-	0.64	0.73	A	(3)a
	Black		-	0.38	0.45	A	(3)b
LVDS differential input voltage		V_{id}	100	-	600	mV	(4)
LVDS common input voltage		V_{ic}	1.0	1.2	1.4	V	(4)
Differential Input Voltage for LVDS Receiver	"H" Level	V_{IH}	-	-	100	mV	-
	"L" Level	V_{IL}	-100	-	-	mV	-
Terminating Resistor		R_T	-	100	-	Ohm	-

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

Note (2) Measurement Conditions:



Vcc rising time is 470µs



Note (3) The specified power supply current is under the conditions at V_{DD} =5.0V, Ta = 25 ±2 ºC, DC Current and fv = 60 Hz, whereas a power dissipation check pattern below is displayed.

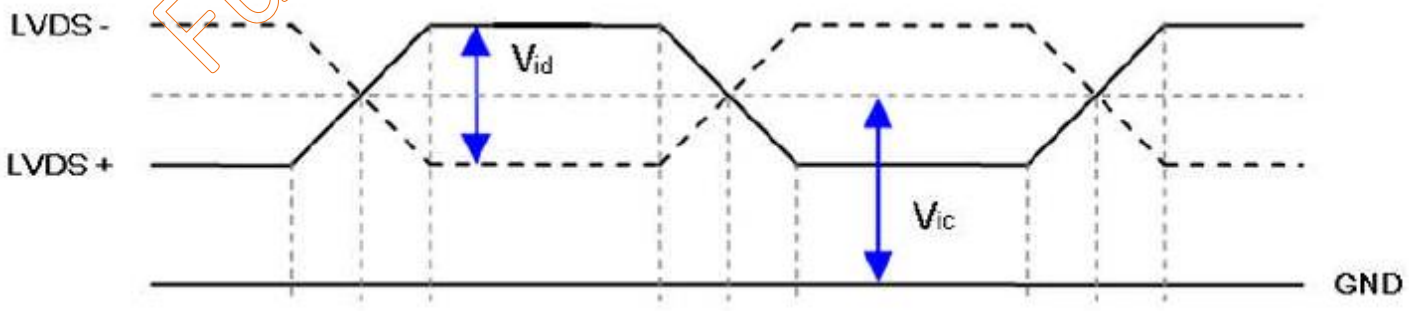
a. White Pattern

Active Area

b. Black Pattern

Active Area

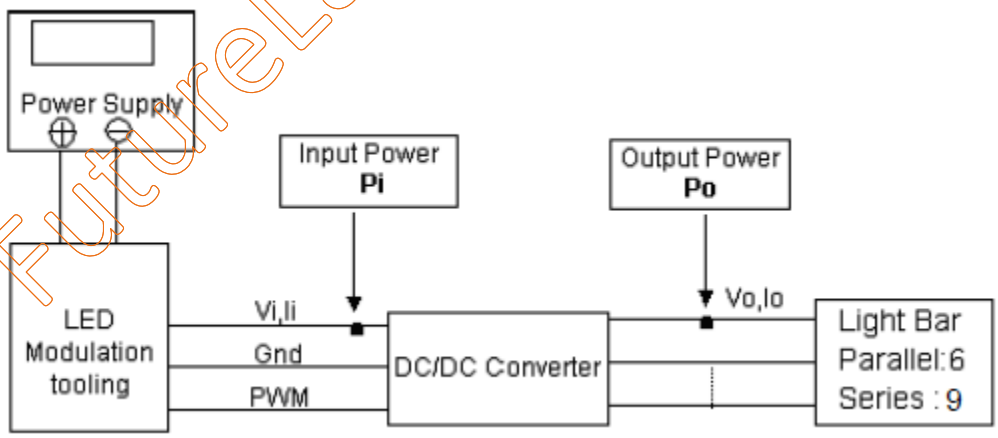
Note (4) VID waveform condition



3.2 Backlight Unit

Parameter		Symbol	Min.	Type	Max.	Unit.	Note
Converter Input Voltage		Vi	10.8	12.0	13.2	VDC	(Duty 100%)
Converter Input Ripple Voltage		ViRP	-	-	500	mV	
Converter Input Current		Ii	0.5	0.65	0.8	ADC	@ Vi = 12V (Duty 100%)
Converter Inrush Current		IiRUSH	-	-	3.0	A	@ Vi rising time=10ms (Vi=12V)
Input Power Consumption		Pi	-	7.8	18.6	W	(1)
EN Control Level	Backlight on	ENLED (BLON)	2.0	3.3	5.0	V	
	Backlight off		0	-	0.3		
PWM Control Level	PWM High Level	Dimming (E_PWM)	2.0	-	5.0	V	
	PWM Low Level		0	-	0.15		
PWM Noise Range		VNoise	-	-	0.1	V	
PWM Control Frequency		f_{PWM}	190	200	20k	Hz	(2)
PWM Dimming Control Duty Ratio		-	5	-	100	%	(2), @ 190Hz<f_{PWM}<1kHz
			20	-	100	%	(2), @ 1kHz≦f_{PWM}<20kHz
LED Life Time		LLED	50,000			Hrs	(3)

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



Note (2) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at Ta = 25 ±2 ºC and Duty 100% until the brightness becomes ≦ 50% of its original value. Operating LED at high temperature condition will reduce life time and lead to color shift.

Note (3) At 190 ~1kHz PWM control frequency, duty ratio range is restricted from 5% to 100%.1K ~20kHz PWM

control frequency, duty ratio range is restricted from 20% to 100%. If PWM control frequency is applied in the range from 1KHz to 20KHZ, The“non-linear”phenomenon on the Backlight Unit may be found. So It’s a suggestion that PWM control frequency should be less than 1KHz.

4. Signal Characteristic

4.1 INPUT SIGNAL TIMING SPECIFICATIONS

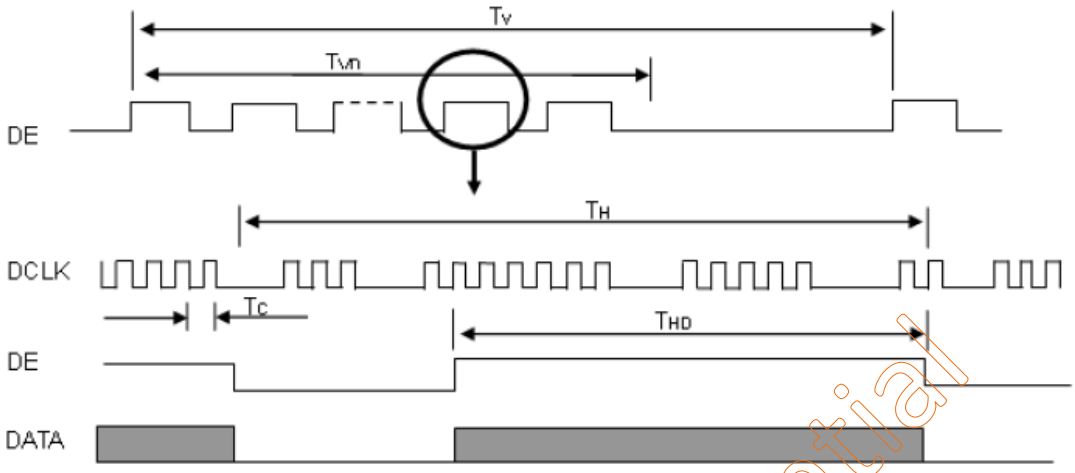
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F_r	60	(70.93)	(75)	MHz	-
	Period	T_c		(14.1)		ns	
	Input cycle to cycle jitter	T_{rcl}	-0.02*Tc		0.02*Tc	ns	(3)
	Input Clock to data	TLVCCS	-0.02*Tc		0.02*Tc	ps	(4)
	Spread spectrum modulation range	F_{clkin_mod}	FC*98%		FC*102 %	MHz	(5)
	Spread spectrum modulation frequency	F_{SSM}			200	KHz	
Vertical Display Term	Frame Rate	F_r	(50)	60	(60)	Hz	Tv=Tvd+Tvb
	Total	T_v	(1090)	(1110)	(1130)	Th	-
	Active Display	T_{vd}	1080	1080	1080	Th	-
	Blank	T_{vb}	Tv-Tvd	(30)	Tv-Tvd	Th	-
Horizontal Display Term	Total	T_h	(1050	(1065)	(1075)	Tc	Th=Thd+Thb
	Active Display	T_{hd}	960	960	960	Tc	-
	Blank	T_{hb}	Th-Thd	(105)	Th-Thd	Tc	-

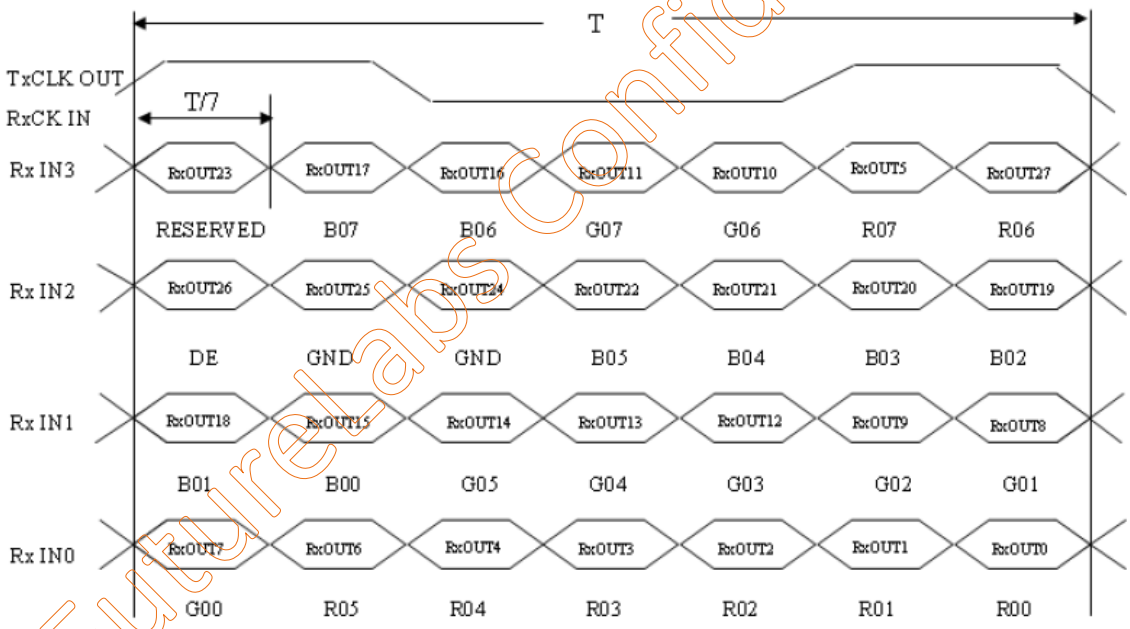
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note (2) The Tv(Tvd+Tvb) must be integer, otherwise, the module would operate abnormally.

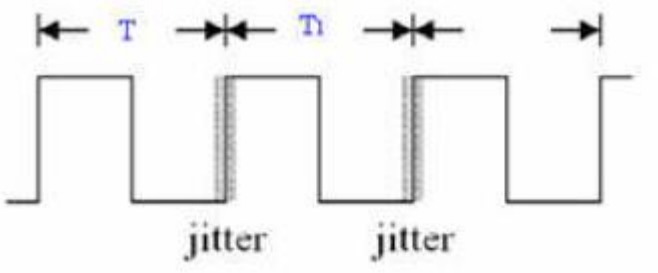
INPUT SIGNAL TIMING DIAGRAM



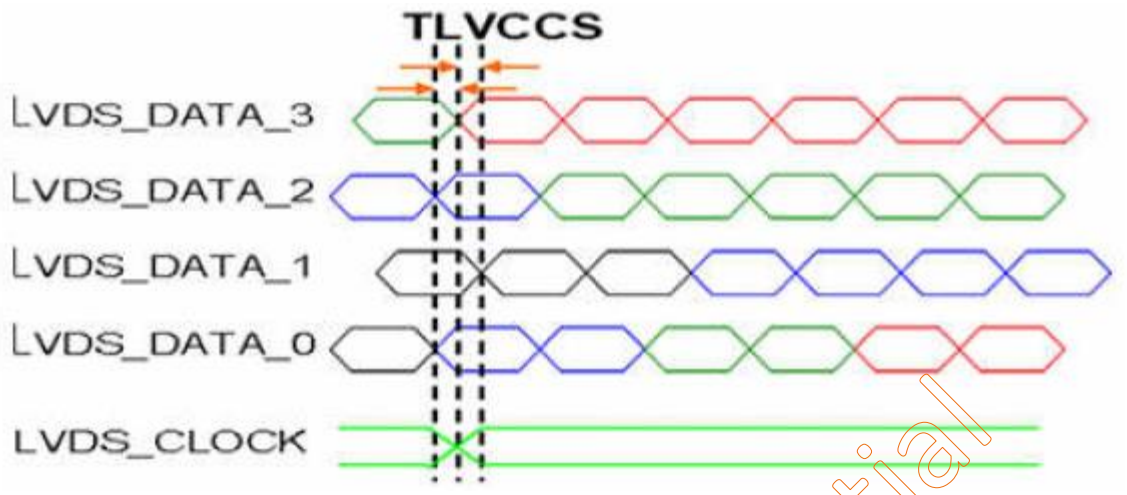
TIMING DIAGRAM of LVDS



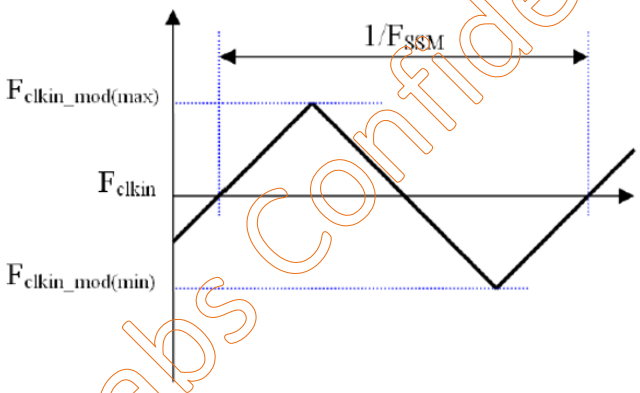
Note (3) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T1 – T I



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

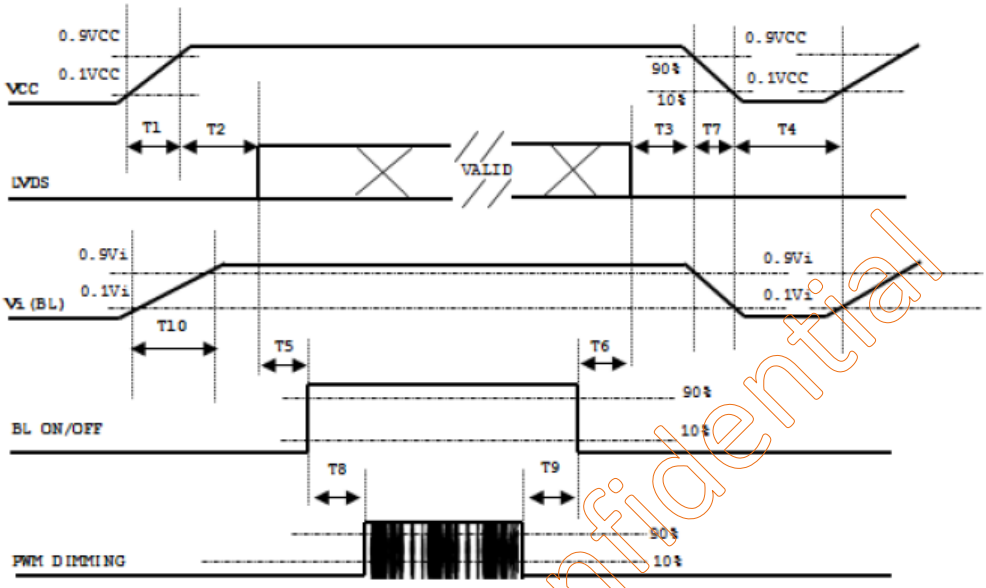


Note (5) The SSCG (Spread spectrum clock generator) is defined as below figures.



4.2 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.



Timing specifications:

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	s
T3	0	-	50	ms
T4	500	-	-	ms
T5	450	-	-	ms
T6	200	-	-	ms
T7	10	-	100	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20	-	50	ms

Note:

(1) The supply voltage of the external system for the module input should be the same as the definition of Vcc.

(2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen.

(3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.

(4) T4 should be measured after the module has been fully discharged between power off and on period.

(5) Interface signal shall not be kept at high impedance when the power is on.

(6) FL won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.

(7) There might be slight electronic noise when LCD is turned off (even backlight unit is also off). To avoid this symptom, we suggest "Vcc falling timing" to follow "T7 spec".

5. INTERFACE PIN DESCRIPTION

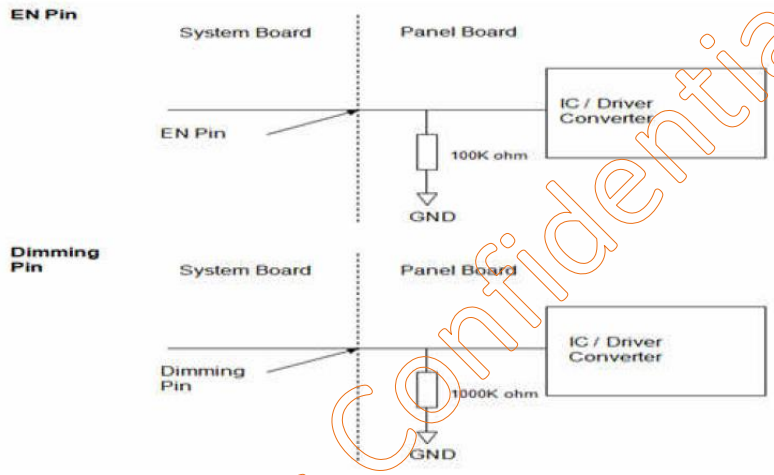
5.1 LCM Connector PIN Assignment

Pin	Name	Description	Note
1	LED _Vcc	+12V Vi power supply	-
2	LED _Vcc	+12V Vi power supply	-
3	LED _Vcc	+12V Vi power supply	-
4	LED _Vcc	+12V Vi power supply	-
5	GND	Ground	-
6	GND	Ground	-
7	GND	Ground	-
8	GND	Ground	-
9	LED_EN	Enable pin	-
10	LED_PWM	Backlight Adjust	-
11	LCD_VCC	LCD logic and driver power 5.0V	-
12	LCD_VCC	LCD logic and driver power 5.0V	-
13	LCD_VCC	LCD logic and driver power 5.0V	-
14	NC	Not connection, this pin should be open	-
15	NC	Not connection, this pin should be open	-
16	NC	Not connection, this pin should be open	-
17	NC	Not connection, this pin should be open	-
18	RXO0-	Negative LVDS differential data input. Channel O0 (odd)	-
19	RXO0+	Positive LVDS differential data input. Channel O0 (odd)	-
20	RXO1-	Negative LVDS differential data input. Channel O1 (odd)	-
21	RXO1+	Positive LVDS differential data input. Channel O1 (odd)	-
22	RXO2-	Negative LVDS differential data input. Channel O2 (odd)	-
23	RXO2+	Positive LVDS differential data input. Channel O2 (odd)	-
24	LCD GND	LCD logic and driver ground	-
25	RXOC-	Negative LVDS differential clock input. (odd)	-
26	RXOC+	Positive LVDS differential clock input. (odd)	-
27	LCD GND	LCD logic and driver ground	-
28	RXO3-	Negative LVDS differential data input. Channel O3 (odd)	-
29	RXO3+	Positive LVDS differential data input. Channel O3 (odd)	-
30	RXE0-	Negative LVDS differential data input. Channel E0 (even)	-
31	RXE0+	Positive LVDS differential data input. Channel E0 (even)	-
32	RXE1-	Negative LVDS differential data input. Channel E1 (even)	-
33	RXE1+	Positive LVDS differential data input. Channel E1 (even)	-

34	LCD GND	LCD logic and driver ground	-
35	RXE2-	Negative LVDS differential data input. Channel E2 (even)	-
36	RXE2+	Positive LVDS differential data input. Channel E2 (even)	-
37	RXEC-	Negative LVDS differential clock input. (even)	-
38	RXEC+	Positive LVDS differential clock input. (even)	-
39	RXE3-	Negative LVDS differential data input. Channel E3 (even)	-
40	RXE3+	Positive LVDS differential data input. Channel E3 (even)	-

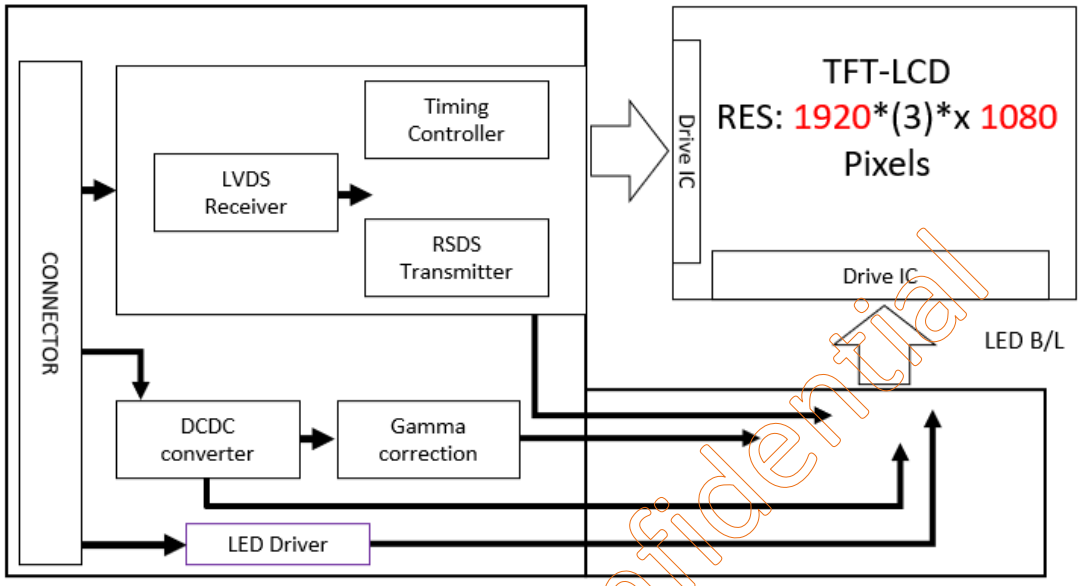
Note (1) Connector Part No.: I-PEX 20455-040E-76 or equivalent.

Note (2) User's connector Part No.: I-PEX 20453-040T-03 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 25 °C.

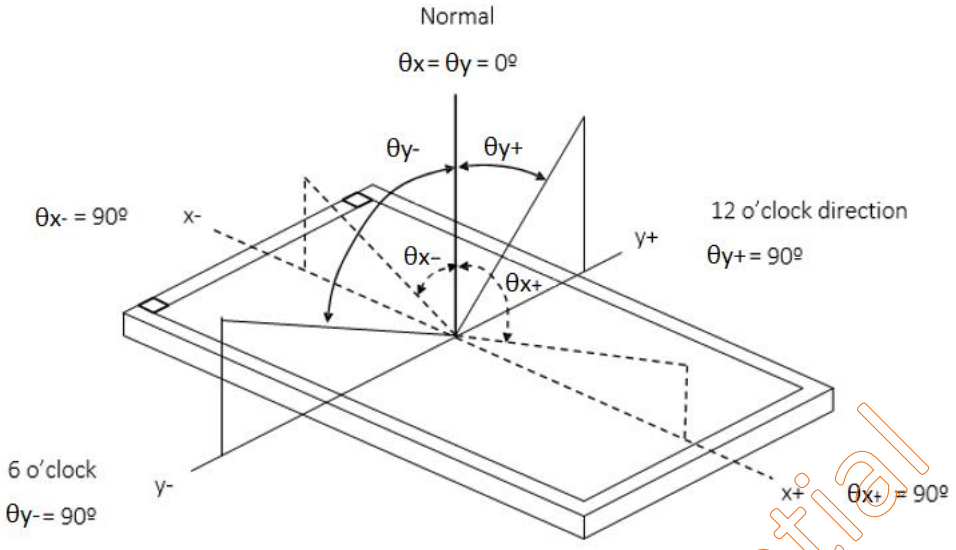
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_X=0°	600	800	-	-	(2)(5)
Response Time		T_R	25°C	-	14	19	ms	(3)
		T_F		-	11	16		
Center Luminance of White		L_C	θ_X=0°, θ_Y =0° Viewing angle at normal direction	280	350	-	cd/m2	(4)(5)
Brightness uniformity				70			%	(5)(6)
Chromaticity	Red	Rx		Typ. -0.05	0.652	Typ. +0.05	-	(1)(5)
		Ry			0.338		-	
	Green	Gx			0.333		-	
		Gy			0.613		-	
	Blue	Bx			0.150		-	
		By			0.050		-	
	White	Wx			0.313		-	
		Wy			0.329		-	
Viewing Angle	Horizontal	θ_X+	CR=10	85	89	-	Deg.	(1)(5)
		θ_X-		85	89	-		
	Vertical	θ_Y+		85	89	-		
		θ_Y-		85	89	-		

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

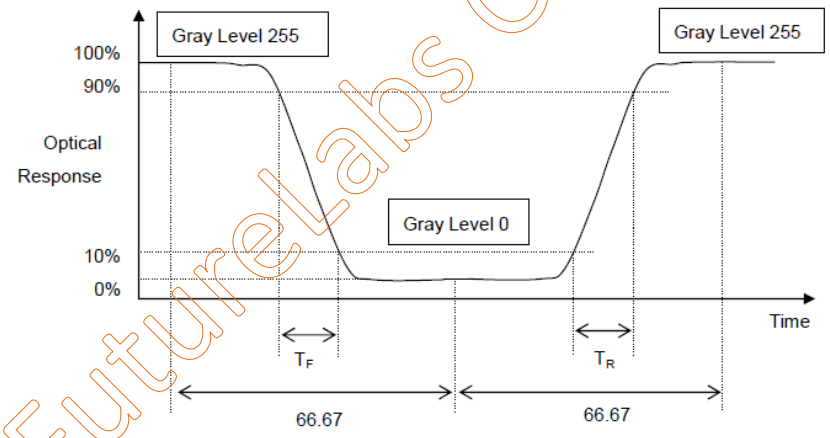


Note 2: Definition of Contrast Ratio (CR)

Measure the viewing angle of Θ= 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:

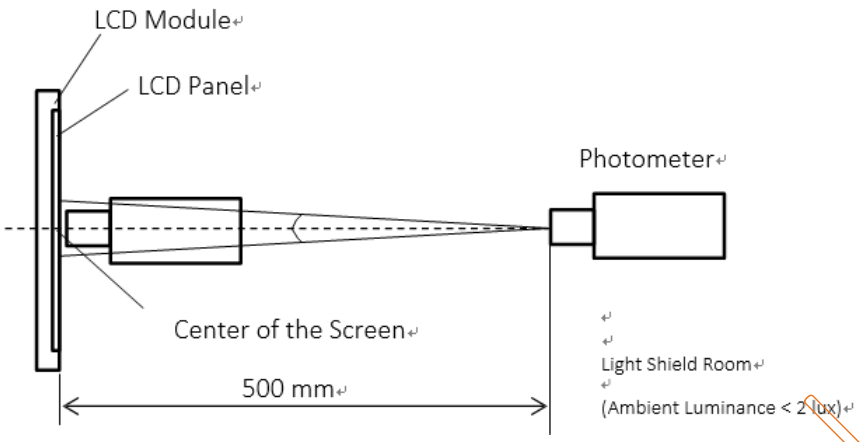
The response time is set initially by defining the "Rising Time (TR)" and the "Falling Time (TF)" respectively. Please refer the figure to the followings:



Note 4: Definition of Brightness (L)

Measure the center area of the panel and the viewing angle of the θx=θy =0°

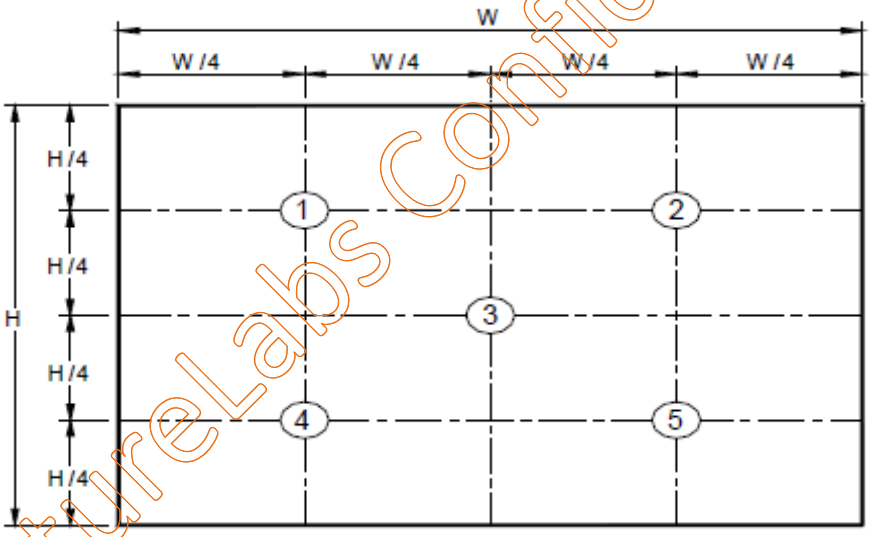
Note 5: The method of optical measurement:



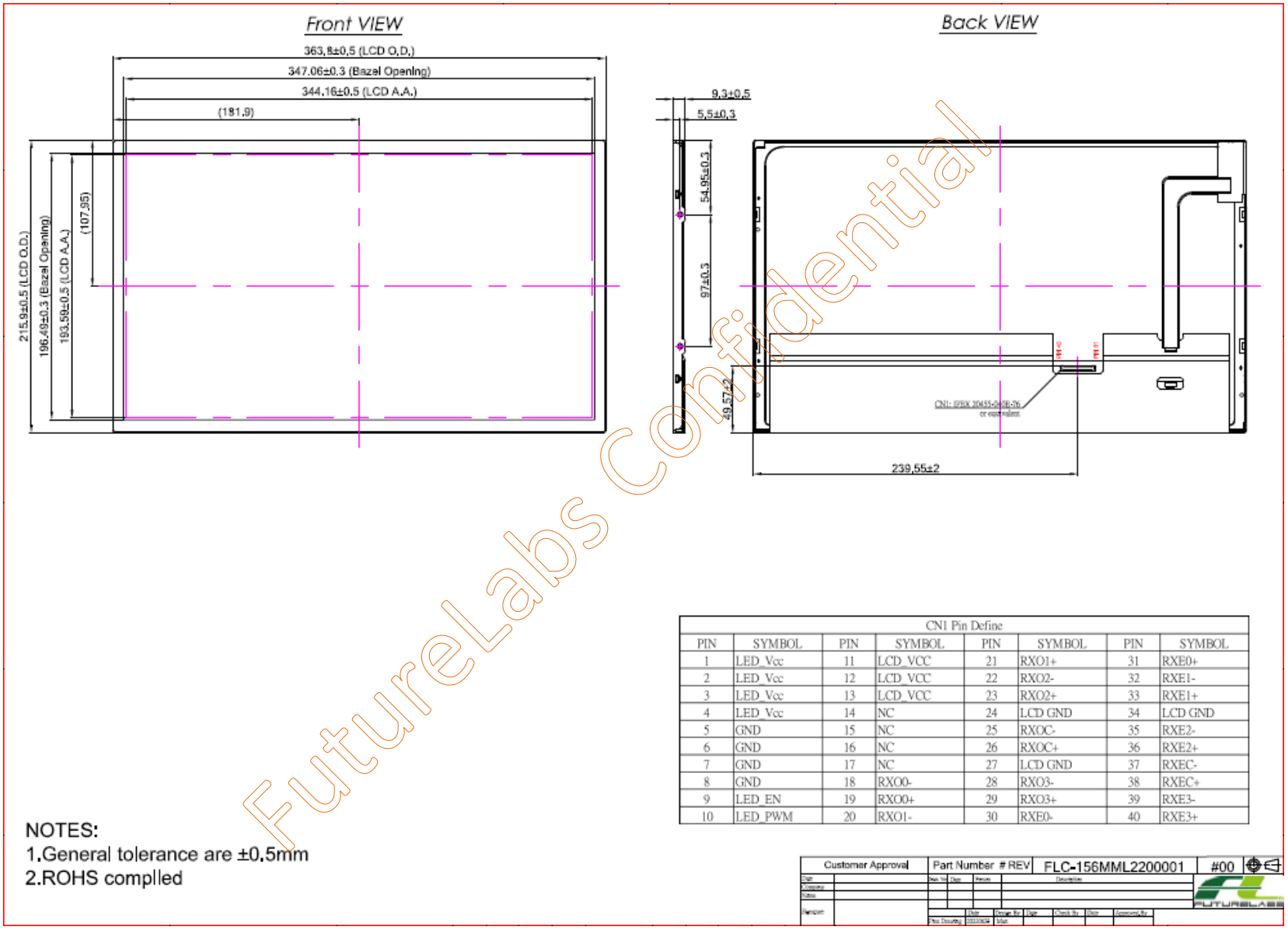
Note 6: Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

δW = (Maximum [L (1), L (2), L (3), L (4)~ L (5)] / Minimum [L (1), L (2), L (3), L (4)~ L (5)]) x 100%



8. DIMENSION AND DRAWING



CN1 Pin Define

PIN	SYMBOL	PIN	SYMBOL	PIN	SYMBOL	PIN	SYMBOL
1	LED_Vcc	11	LCD_VCC	21	RXO1+	31	RXE0+
2	LED_Vcc	12	LCD_VCC	22	RXO2-	32	RXE1-
3	LED_Vcc	13	LCD_VCC	23	RXO2+	33	RXE1+
4	LED_Vcc	14	NC	24	LCD GND	34	LCD GND
5	GND	15	NC	25	RXOC-	35	RXE2-
6	GND	16	NC	26	RXOC+	36	RXE2+
7	GND	17	NC	27	LCD GND	37	RXEC-
8	GND	18	RXO0-	28	RXO3-	38	RXEC+
9	LED_EN	19	RXO0+	29	RXO3+	39	RXE3-
10	LED_PWM	20	RXO1-	30	RXE0-	40	RXE3+

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°C ± 5°C and the humidity is below 60% RH.