Product Specification

PART NUMBER # REV: FLC-150GML2000SA1#00

DESCRIPTION: TFT 15.0”, 1024(H)*768(V), LVDS,
16.7M Color, 300CD

( ) Preliminary Specification
(V) Approved Specification

Customer Name:	
Signature:	**Date:**

PREPARED BY	**REVIEWED BY**
Renee Huang	*David*

Revision History

Version	Date	Page	Description	Note
V1.0	2022/10/27		First Edition	

Table of Content

1. GENERAL DESCRIPTION

1.1 Description

15.0 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 1024 x 768 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	15.0”	Inch
2	Pixel Number	1024 (H) x 3(RGB)x 768 (V)	Pixels
3	Outline Dimension	326.5(W)× 253.5 (V) ×9 (D) 326.5(W)× 253.5 (V) ×9.6 (D)(Max.)	mm
4	Active Area	304.1 (W) x 228.1 (H)	mm
5	Pixel Pitch	0.297(W) x 0.297(H)	mm
6	Display Colors	16.7M / 262K	
7	Pixel Arrangement	RGB vertical stripe	-
8	Display Mode	Normally Black	-
9	Electrical Interface	LVDS	-
10	Surface Treatment	Anti-glare, Hard Coating(3H)	-
11	Brightness	300 (Typ.)	cd/m2
12	Contrast Ratio	2500 (Typ.)	-
13	Power Supply Voltage	3.3V for LCD – 12V for Backlight	
14	Power Consumption	Module: 6.62W Backlight System: 4.8W (Typ.)	W

2. ABSOLUTE MAXIMUM RATING

2.1 Electrical Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max		
TFT Power Supply Voltage	V_{CC}	-0.3	-	4	V	(1)
Logic Input Voltage	V_{IN}	-0.3	-	4	V	
Converter Voltage	V_i	-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).

2.2 Environment Absolute Rating

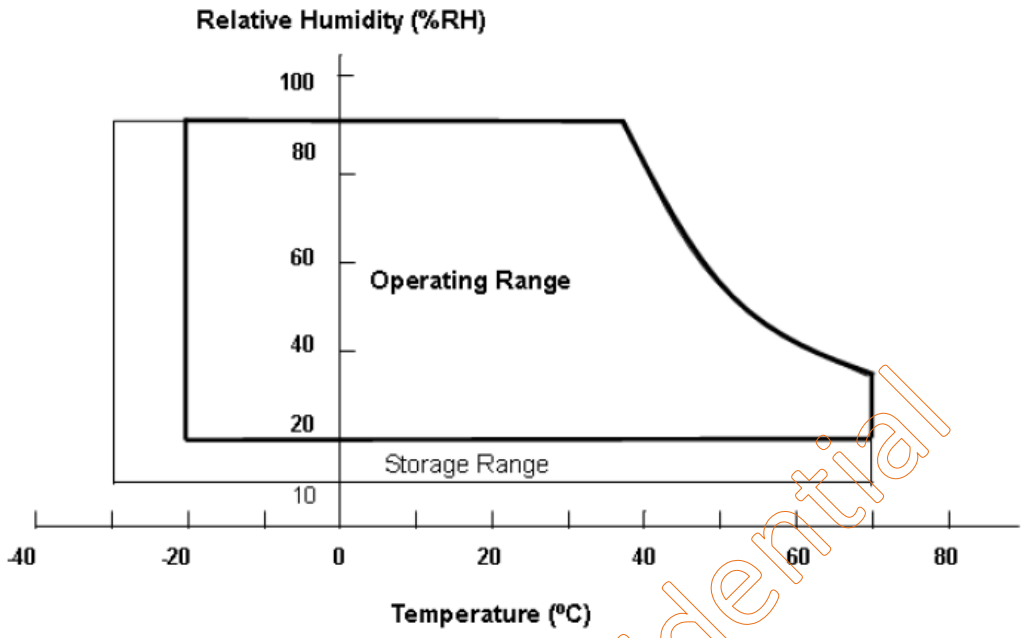
Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Operating Ambient Temperature	T_{OP}	-20	-	+70	°C	(1)(2)
Storage Temperature	T_{ST}	-30	-	+70	°C	

Note (1) 90 %RH Max./ Wet-bulb temperature should be 39 °C Max./ No condensation.

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

Note (3) In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before test.

Note (4) Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.



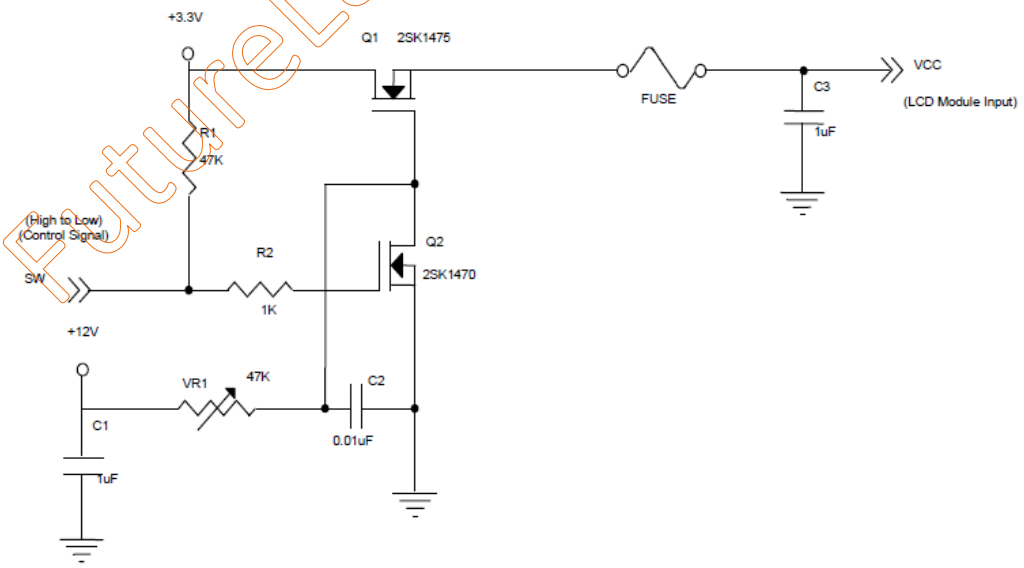
3. ELECTRICAL CHARACTERISTICS

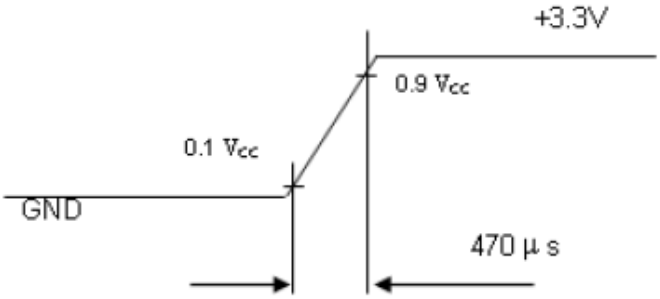
3.1 TFT LCD Module

Item		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	3.0	3.3	3.6	V	-
Ripple Voltage		V_{RP}	-	-	100	mVp-p	
Inrush Current		I_{INRUSH}	-	-	2.0	A	(2)
Power Supply Current	White	I_{CC}	-	550	660	mA	(3)a
	Black		-	440	530	mA	(3)b
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	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:





Note (3) The specified power supply current is under the conditions at VDD=3.3V, Ta=25 ± 2 ºC, DC current and fv=60Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

Active Area

b. Black Pattern

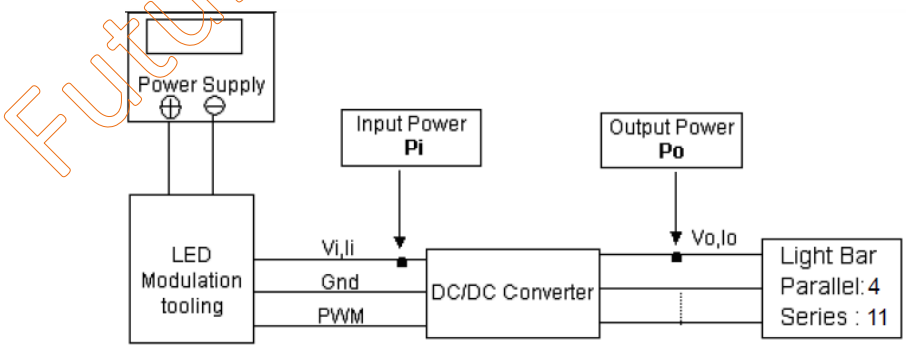
Active Area

3.2 Backlight Characteristics

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

Parameter		Symbol	Min.	Typ.	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	0.3	0.4	0.5	ADC	@Vi=12V (Duty 100%)
Converter Power Supply Current		IiRUSH	-	-	5.0	A	@ Vi rising time=10ms (Vi=12V)
BLU Power consumption		Pi	-	4.8	5.4	W	(1)
EN Control Level	Backlight on	ENLED (BLON)	2.0	3.3	5.0	V	
	Backlight off		0	-	0.15	V	
PWM Control Level	PWM High Level	Dimming (E_PWM)	2.0	-	5.0	V	
	PWM Low Level		0	-	0.15	V	
PWM Noise Range		VNoise	-	-	0.1	V	
PWM Control Frequency		fPWM	190	200	20K	Hz	(2)
PWM Dimming Control Duty Ratio		-	5	-	100	%	(2), @ 190Hz<fPWM<1kHz
			20	-	100	%	(2), @ 1kHz≦fPWM<20kHz
LED life Time (Typical)		LL	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 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.

Note (3) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at Ta = 25 ±2 °C 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.

4. Signal Characteristic

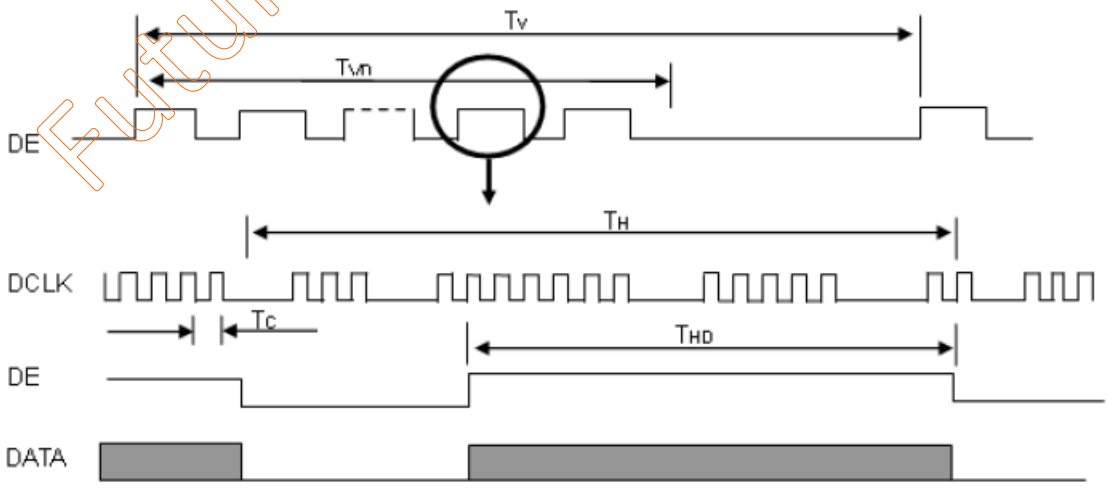
4.1Timing Chart

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	53.35	65	80	MHZ	-
	Period	Tc	12.5	15.38	18.75	ns	
	Input cycle to cycle jitter	Trd	-	-	200	ns	(a)
	Input Clock to data skew	TLVCCS	-0.02*Tc	-	0.02*Tc	ps	(b)
	Spread spectrum modulation range	F_{clkin_mod}	-	-	1.02*Fc	MHz	(c)
	Spread spectrum modulation frequency	F_{SSM}	-	-	200	KHz	
Vertical Display Term	Frame Rate	Fr	55	60	70	Hz	Tv=Tvd+Tvb
	Total	Tv	780	806	840	Th	-
	Active Display	Tvd	768	768	768	Th	-
	Blank	Tvb	Tv-Tvd	38	Tv-Tvd	Th	-
Horizontal Display Term	Total	Th	1240	1344	1360	Tc	Th=Thd+Thb
	Active Display	Thd	1024	1024	1024	Tc	-
	Blank	Thb	Th-Thd	320	Th-Thd	Tc	-

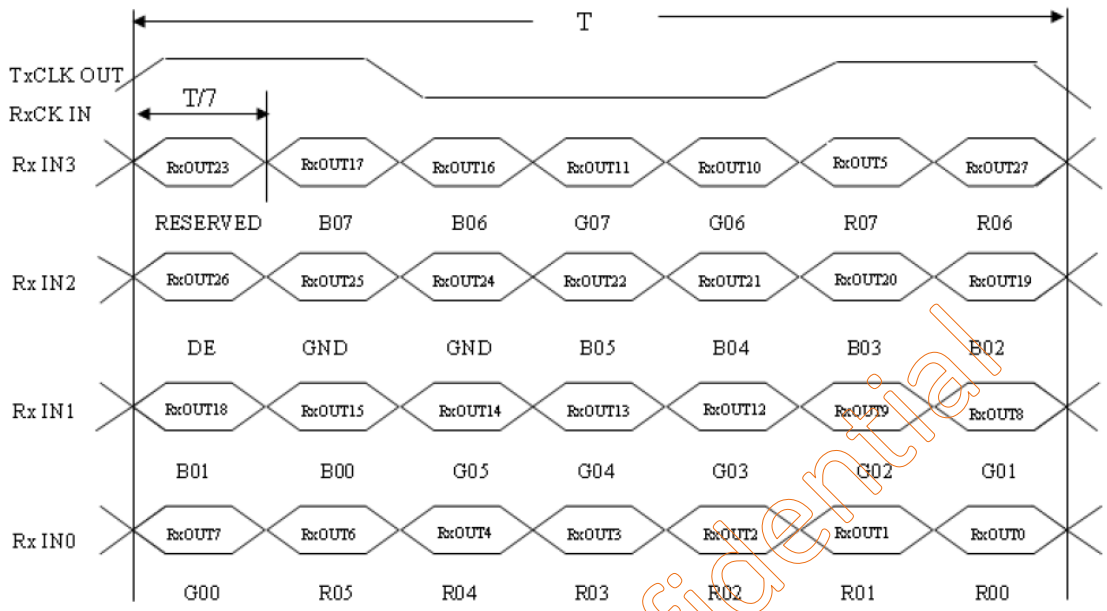
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

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

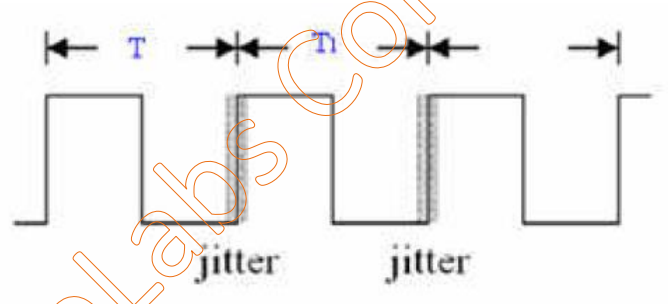
INPUT SIGNAL TIMING DIAGRAM



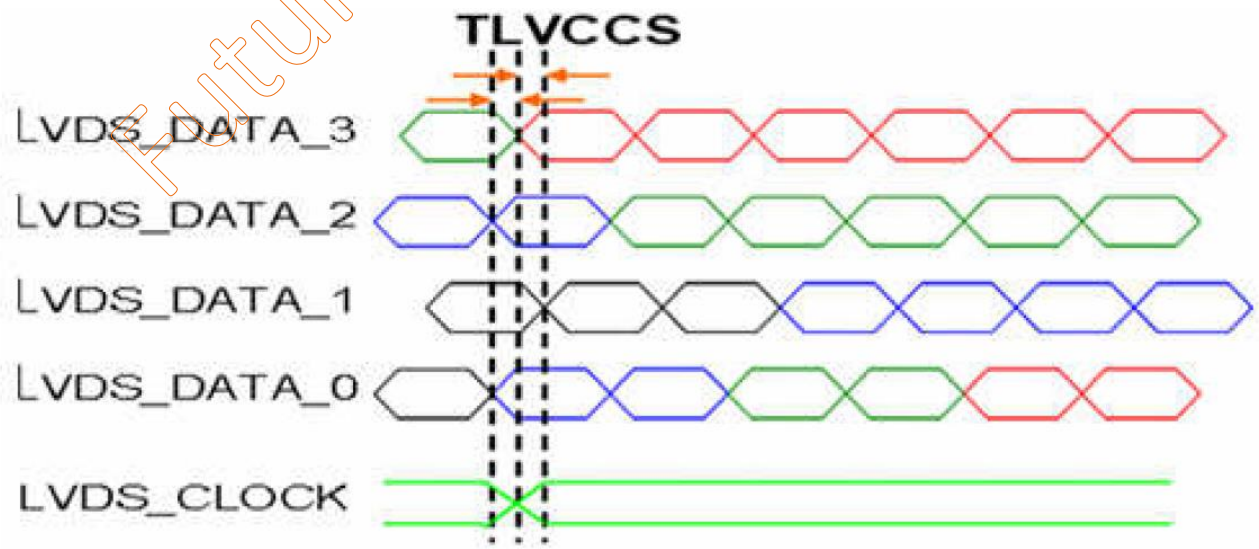
TIMING DIAGRAM of LVDS



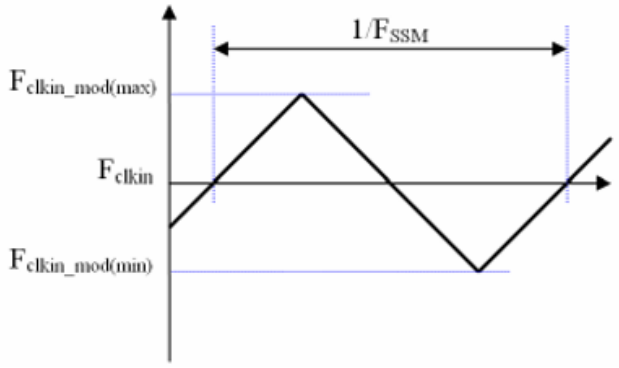
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T1 – TI



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

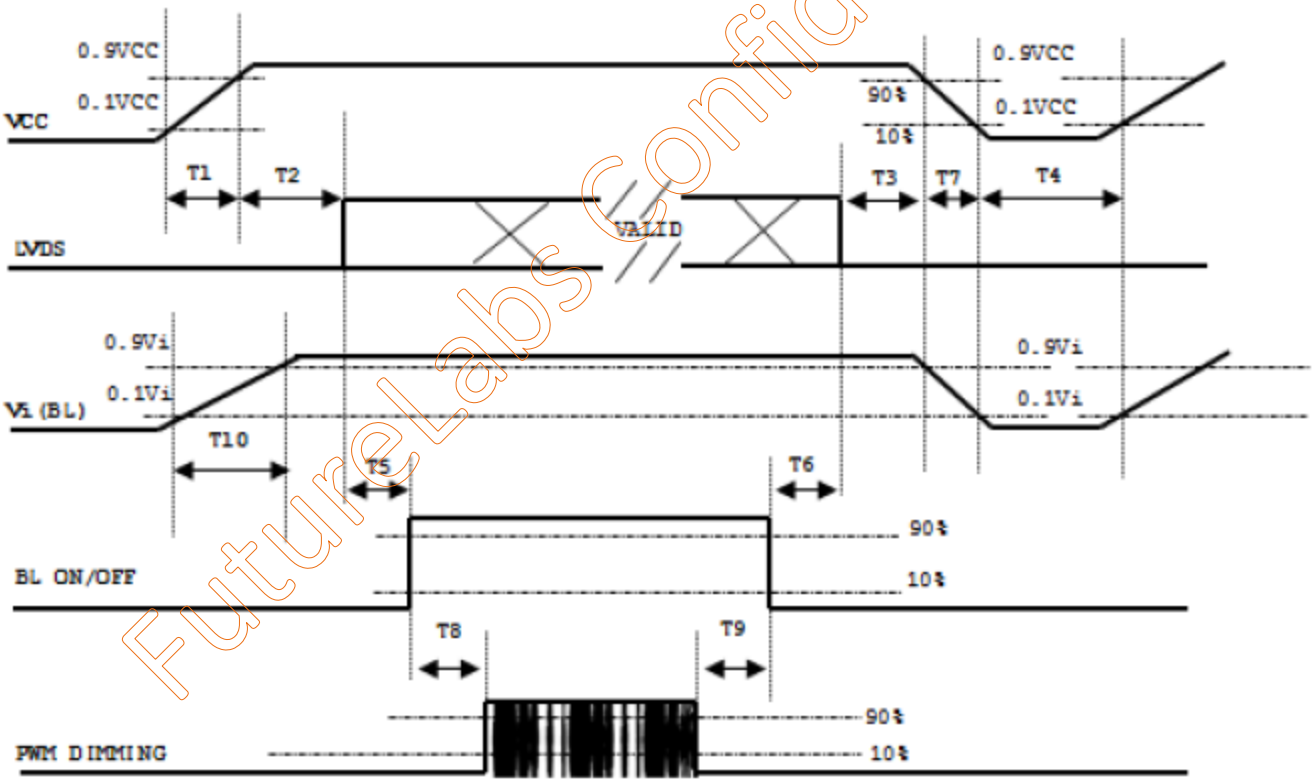


Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



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.



Parameter	Values			Unit
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	450	-	-	ms
T6	200	-	-	ms
T7	10	-	100	ms
T10	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). Toavoid this symptom, we suggest "Vcc falling timing" to follow "T7 spec"

4.3 SCANNING DIRECTION

The following figures show the image see from the front view. The arrow indicates the direction of scan.

Fig.1 Normal Scan

PCBA on the top side

Fig.2 Reverse Scan

CBA on the top side

Fig. 1 Normal scan (pin 4, LR/UD = High or NC)

Fig. 2 Reverse scan (pin 4, LR/UD = Low)

5. INTERFACE PIN DESCRIPTION

5.1 LCM Connector PIN Assignment

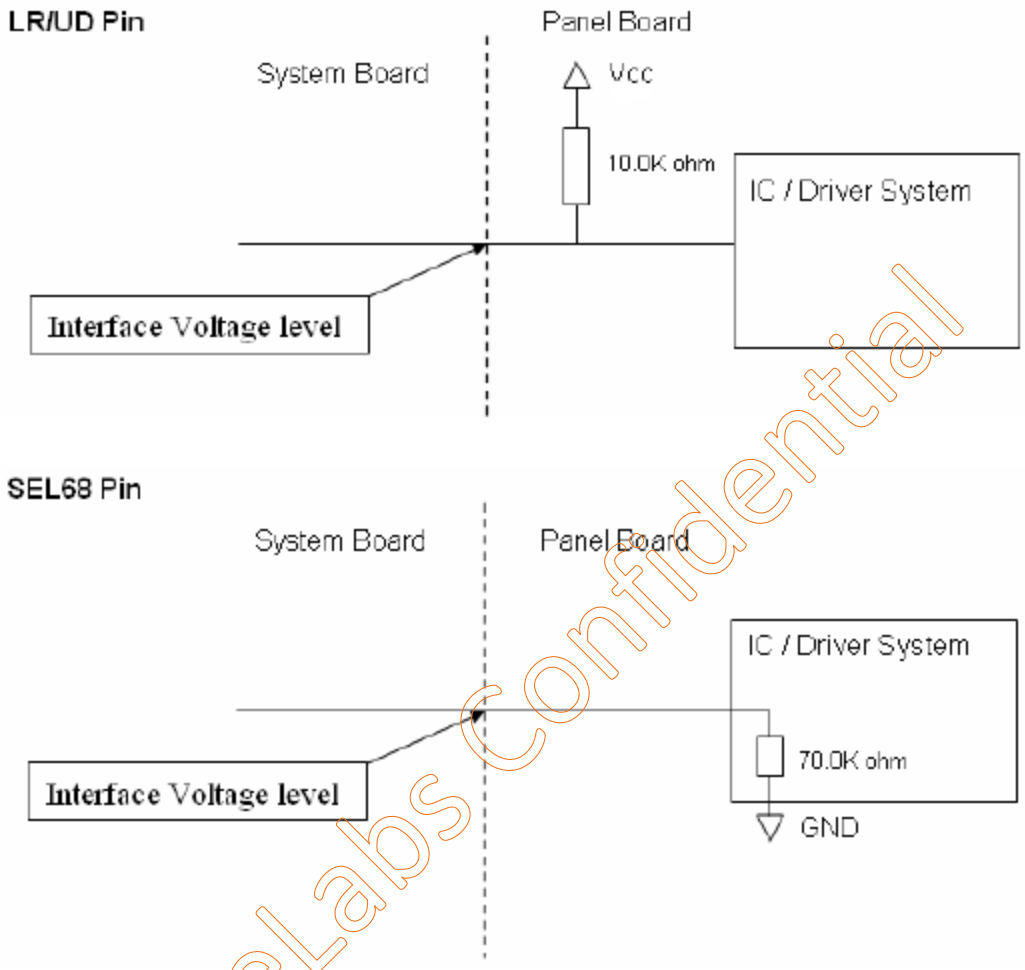
Pin No.	Symbol	Description	Note
1	VCC	Power Supply +3.3V(typical)	
2	VCC	Power Supply +3.3V(typical)	
3	NC	No Connection	Note (4)
4	LR/UD	Reverse Scan Control H or NC = Normal Mode. L = Horizonta/ Vertical Reverse Scan.	Note (3)
5	RX0-	LVDS Differential Data Input	
6	RX0+	LVDS Differential Data Input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

Note (1) Connector Part No.: STM MSB240420HDA 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.

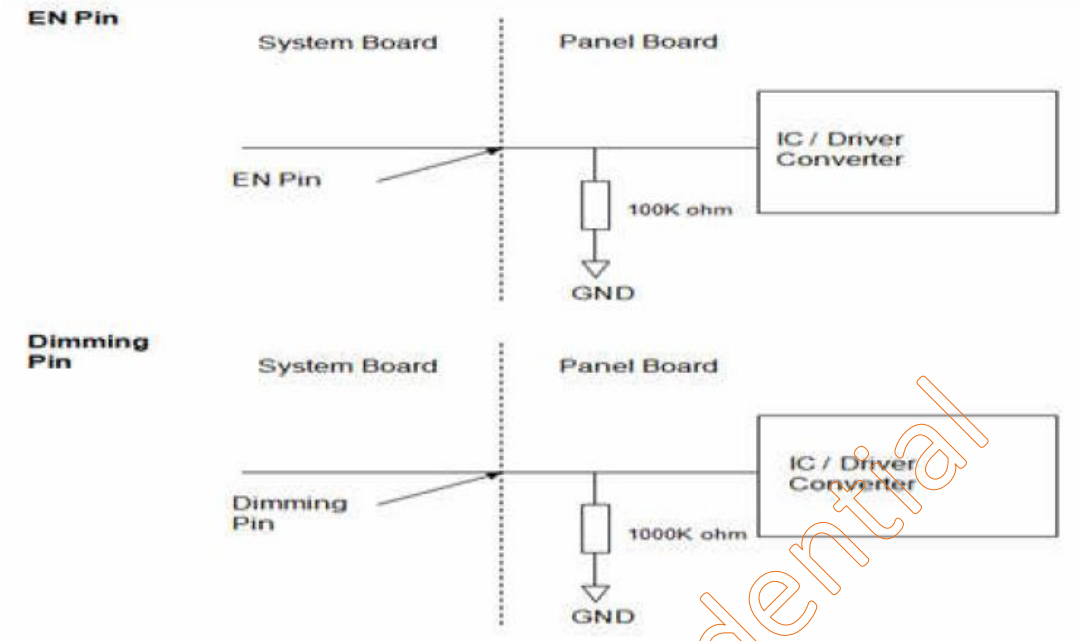


5.2 Backlight and LED Driver Connector PIN Assignment

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

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

Note (2)User's connector Part No.: MOLEX 51146-0500 or equivalent.



5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	Red(253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
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	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale Of Blue	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
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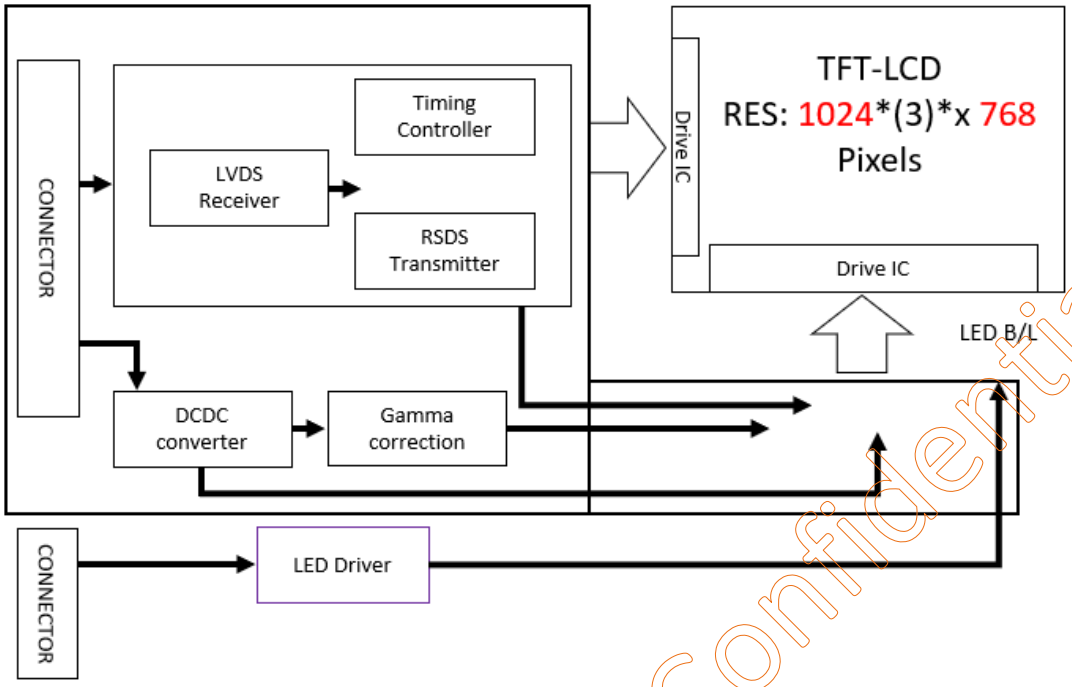
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Note (1)0: Low Level Voltage, 1: High Level Voltage

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.

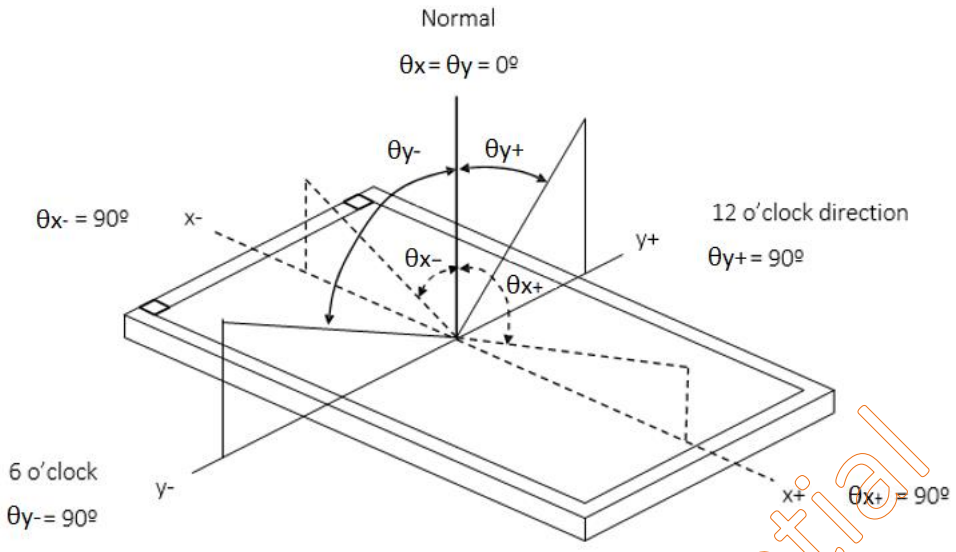
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_X=0°	1800	2500	-	-	(4)
Response Time		T_R	25°C	-	16	21		
		T_F		-	7	14		
Center Luminance of White		L_C	θ_X=0°, θ_Y =0° Viewing angle at normal direction	240	300	-	cd/m2	(4)
Brightness uniformity				75	80	-	%	
Chromaticity	Red	Rx		0.597	0.647	0.697	-	(4)
		Ry		0.288	0.338	0.388	-	
	Green	Gx		0.271	0.321	0.371	-	
		Gy		0.556	0.606	0.656	-	
	Blue	Bx		0.107	0.157	0.207	-	
		By		0.000	0.039	0.089	-	
	White	Wx		0.263	0.313	0.363	-	
		Wy		0.279	0.329	0.379	-	
Viewing Angle	Horizontal	θ_{X+}	CR≧10	80	88	-	Deg.	(1)
		θ_{X-}		80	88	-		
	Vertical	θ_{Y+}		80	88	-		
		θ_{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±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

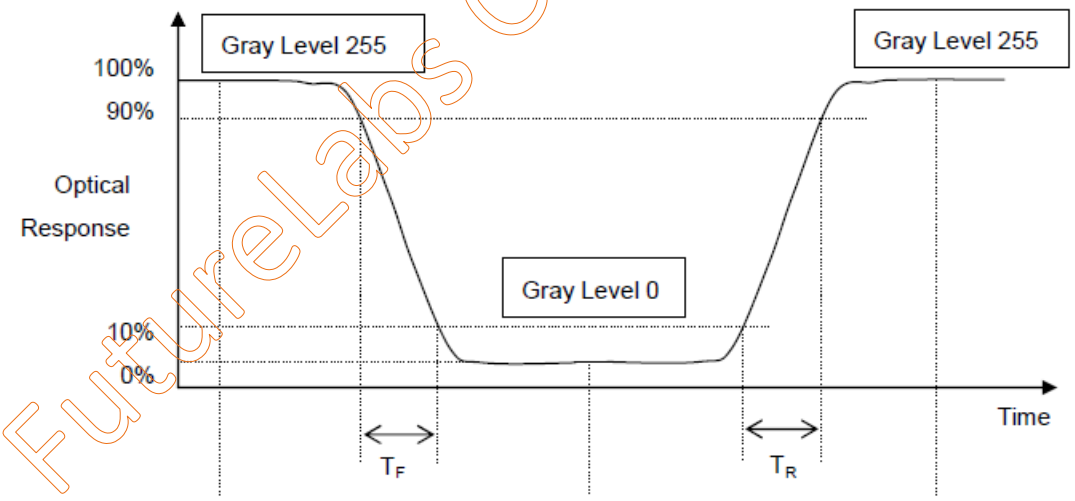


Note 2: Definition of Contrast Ratio (CR)

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:

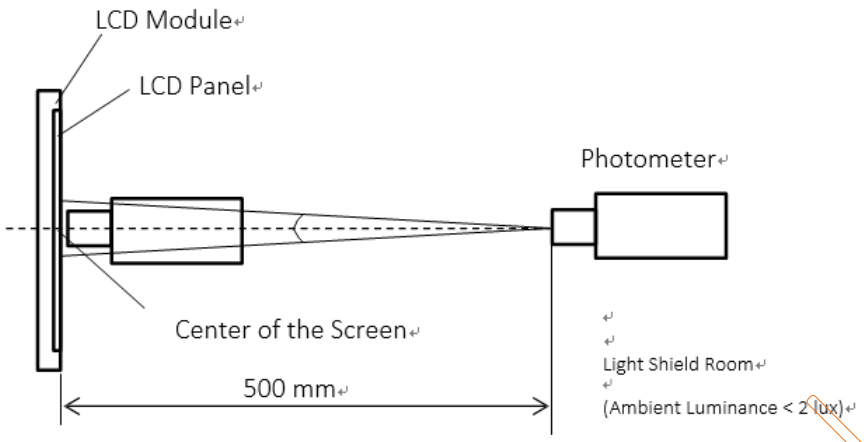
The response time is set initially by defining the "Rising Time (TR)" and the "Falling Time (TF)" respectively. Please refer the figure to the followings:



Note 4: Definition of Brightness (L)

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

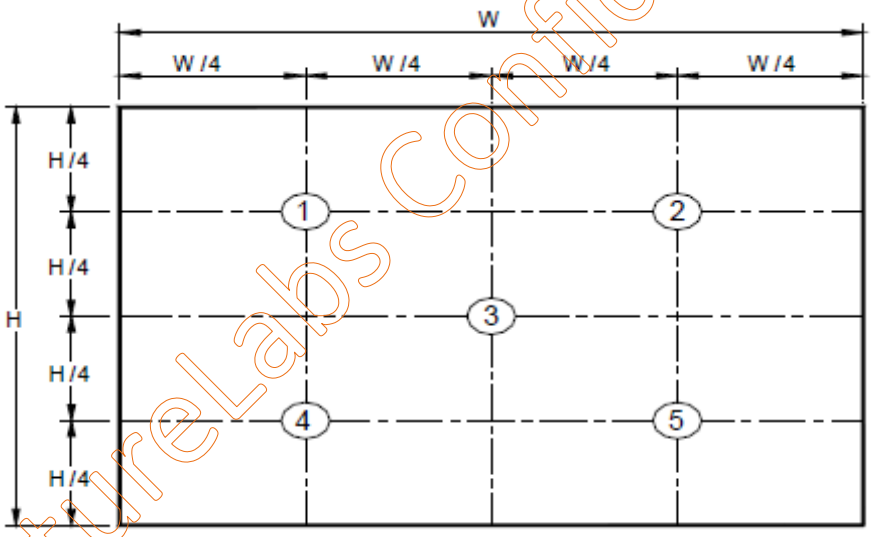
Note 5: The method of optical measurement:



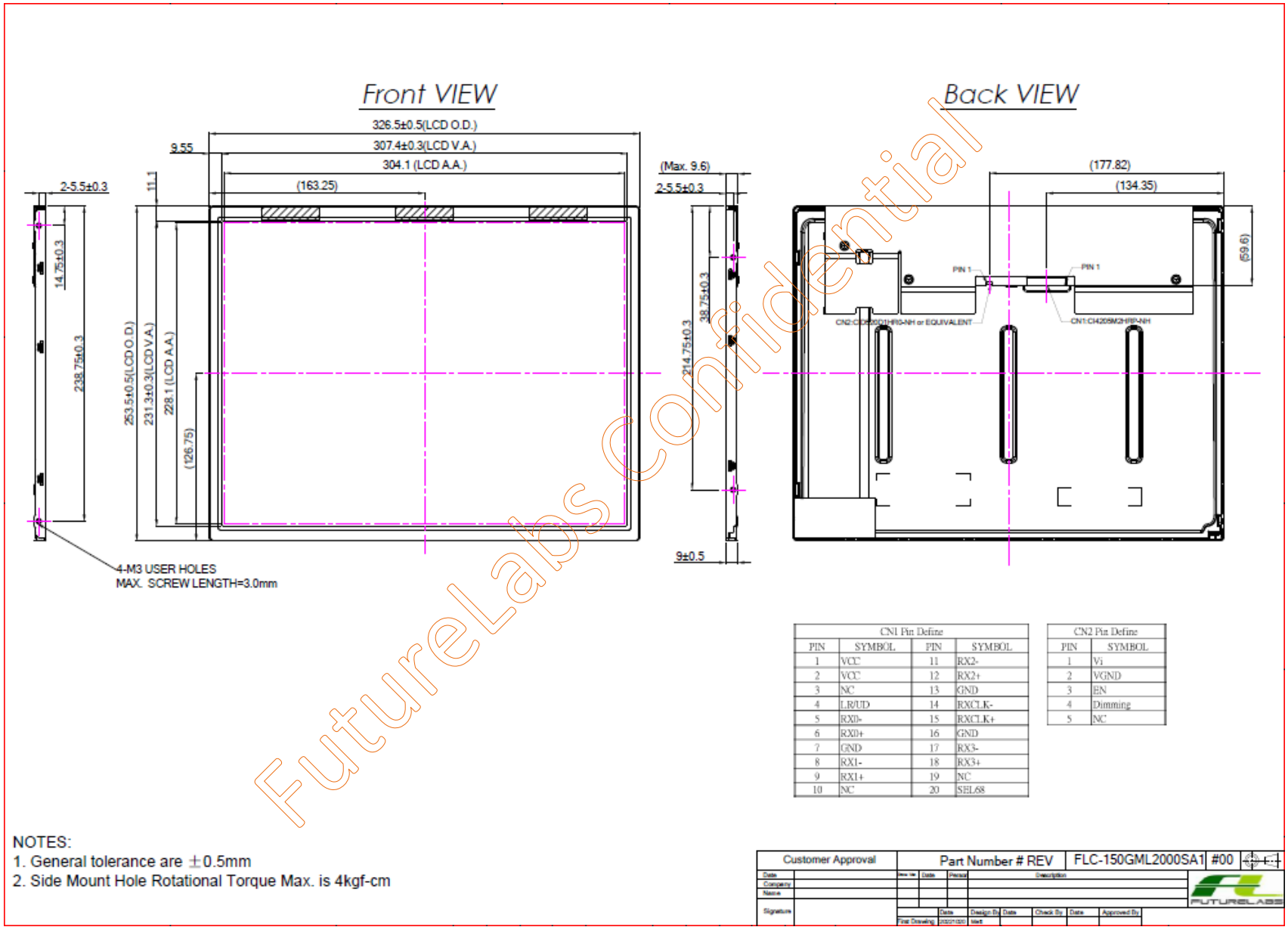
Note 6: Definition of White Variation (δW):

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
1	VCC	11	RX2-
2	VCC	12	RX2+
3	NC	13	GND
4	LR/UD	14	RXCLK-
5	RX0-	15	RXCLK+
6	RX0+	16	GND
7	GND	17	RX3-
8	RX1-	18	RX3+
9	RX1+	19	NC
10	NC	20	SEL68

CN2 Pin Define	
PIN	SYMBOL
1	Vi
2	VGND
3	EN
4	Dimming
5	NC

NOTES:
1. General tolerance are ±0.5mm
2. Side Mount Hole Rotational Torque Max. is 4kgf-cm

Customer Approval	Part Number # REV	FLC-150GML2000SA1	#00

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.