TFT Product Specification

◇ TENTATIVE SPECIFICATION

◆ APPROVED SPECIFICATION

Part Number: FLC-156MML2000SA1

Description: TFT 15.6’’W 1920*1080 Full View LVDS 450CD

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Approved by	
Date	

Revision History

Version	Date	Page	Description	Note
V0.1	2017/12/27		First Edition	
V0.3	2018/01/08		Release Edition	
V0.4	2018/03/09		Update 1. Transmissive mode/To&Ts/Electrical absolute rating 2. Black light and PWM control level 3. ME drawing	
V0.5	2018/04/09	9- 14	Adjust Signal Characteristics, Backlight Pinout Grafic Adjustment	
V0.6	2018/06/19	11 12-13	1. Modify Timing specifications 2. ADD LVDS DATA MAPPING TABLE/ COLOR DATA INPUT ASSIGNMENT	
V0.7	2019/07/20		LED pinout	

Table of Content

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 the FHD, 1920x1080 screen and 16.2M 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	15.6w	Inch
2	Pixel Number	1920 (H) x RGB x 1080 (V)	Pixels
3	Outline Dimension	363.8 (H) ×215.9 (V) ×9.3 (D)	mm
4	Active Area	344.16 (H) × 193.59 (V)	mm
5	Display Colors	16.2M	- -
6	Pixel Arrangement	RGB vertical stripe	- -
7	Display Mode	Full View / Normally Black / Transmissive	- -
8	Electrical Interface	LVDS	- -
9	Surface Treatment	Anti-Glare, 3H hard coating	- -
10	Brightness	450 (Typ.)	cd/m2
11	Contrast Ratio	800 (Typ.)	- -
12	Total Power Consumption (Typ)	Total 16W	W
13	Operating Temperature	-30 ~ 85	°C
14	Storage Temperature	-40 ~ 90	°C

2. ABSOLUTE MAXIMUM RATING

2.1 Electrical Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Power supply voltage	VCC	-0.3	-	3.6	V	(1)
Logic Input Voltage	VIN	-0.3	-	4.0	V	
Converter Voltage	LED_Vin	0	12.0	18.0		Duty=100% (1)(2)
Enable Voltage	LED_EN	0	3.3/5	7	V	
Backlight Adjust	LED_PWM	0	3.3/5	7	V	Pulse width≦10msec. and duty≦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	-30		85	°C	Ta=25°C
Storage Temperature	Tstg	-40		90	°C	

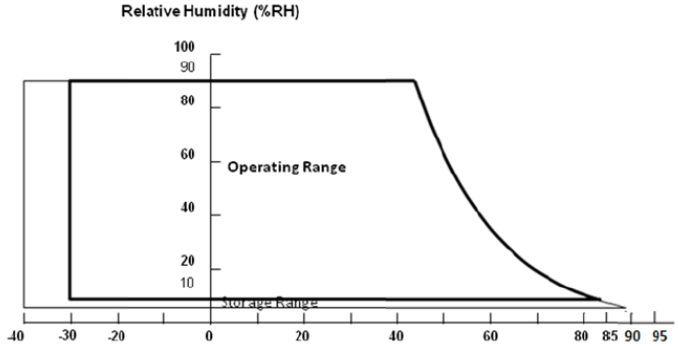
Note (1) Temperature and relative humidity range is shown in the figure below,

(a) 90% RH Max.. (Ta≦40°C)

(b) Wet-bulb temperature should be 39°C Max. (Ta>40°C)

(c) No condensation

(2) The absolute maximum rating values of this product are not allowed to be exceeded at any times. The module should not used over the absolute max. rating value. It'll cause permanently unrecoverable function fail in such an condition.



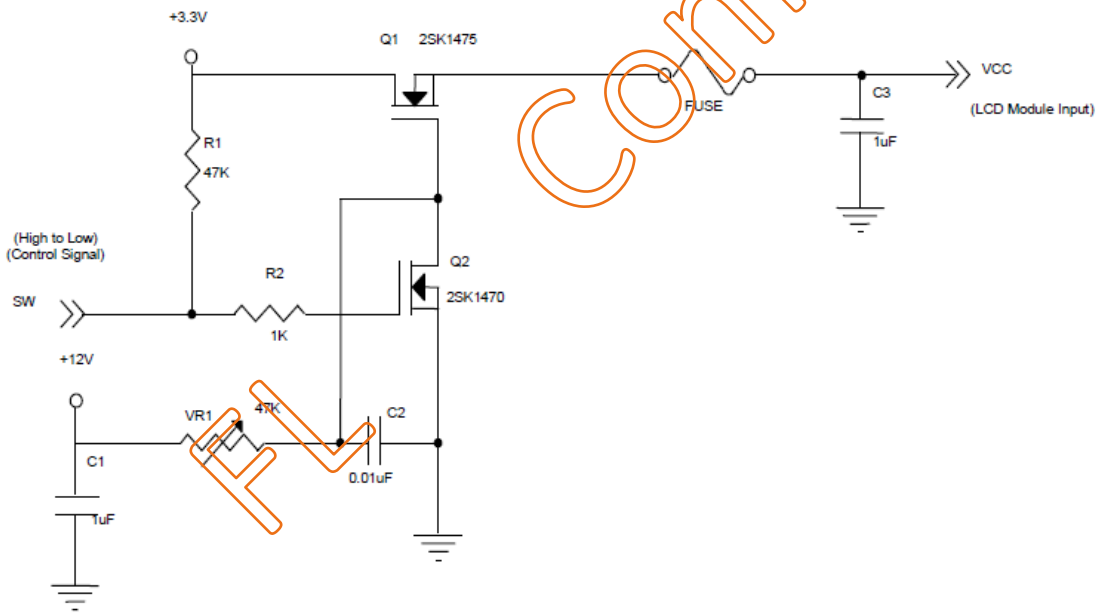
3. ELECTRICAL CHARACTERISTICS

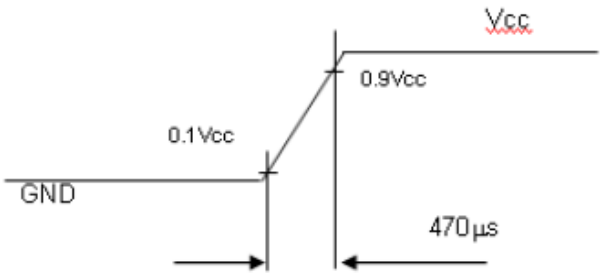
3.1 LCM

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		VCC	3.0	3.3	3.6	V	
Ripple Voltage		V_{RP}	--	--	150	mV	
Rush Current		I_{RUSH}	--	--	3.0	A	(2)
Power Supply Current	White		--	(1.22)	(1.5)	A	(3)
	Black		--	(0.51)	(0.7)	A	
	Vertical Stripe		--	(0.82)	(1)	A	
Power Consumption		P_{LCD}	--	4	5	W	
LVDS differential input voltage		Vid	200	--	600	mV	(4)
LVDS common input voltage		Vic	1.0	1.2	1.4	V	(4)
Terminating Resistor		R_T		100		Ohm	

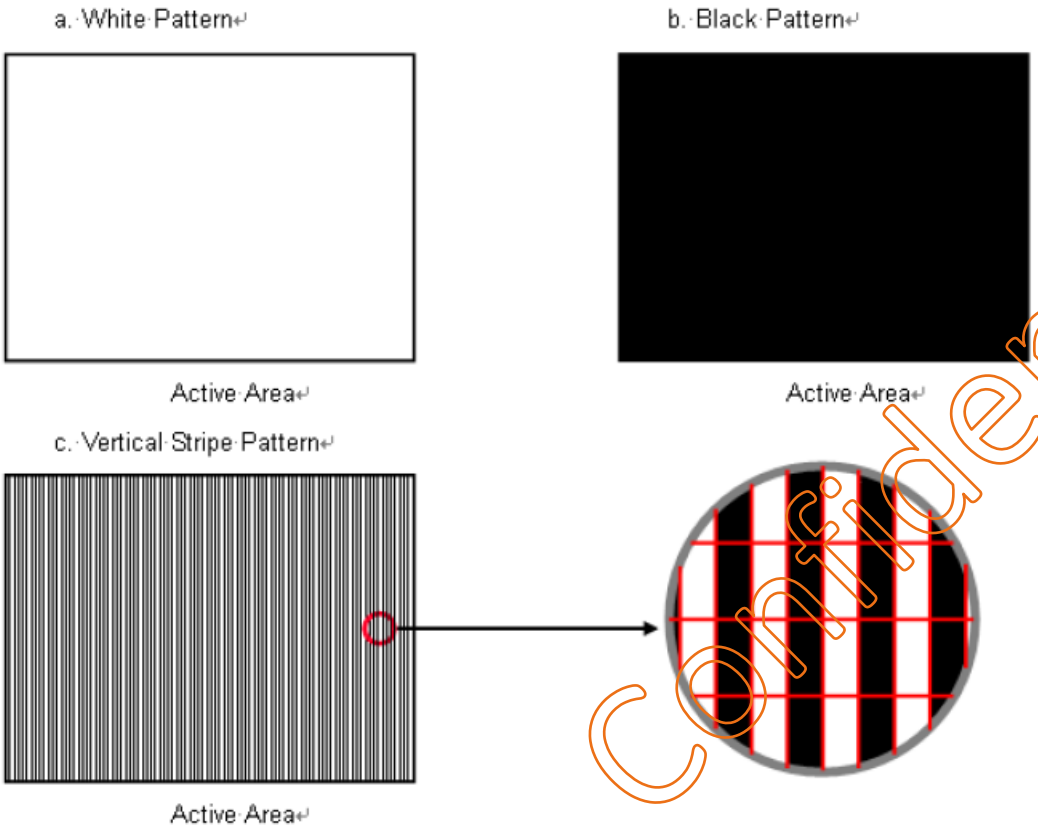
Note (1) The assembly should be always operated within above ranges. Ta = 25 ± 2 ºC

Note (2) Measurement Conditions:

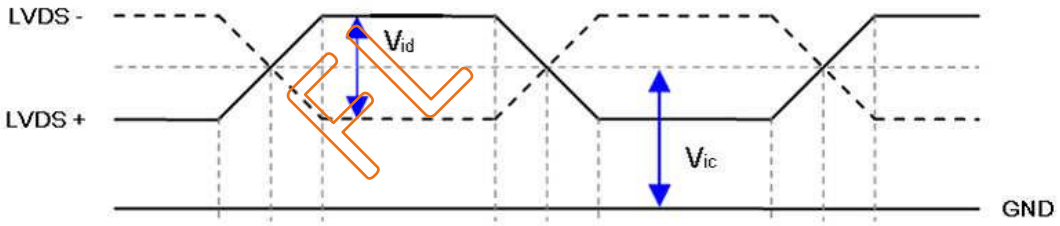




Note (3) The specified power supply current is under the conditions at Vcc=3.3V, Fr=60Hz, whereas a power dissipation check pattern below is displayed



Note (4) VID waveform condition



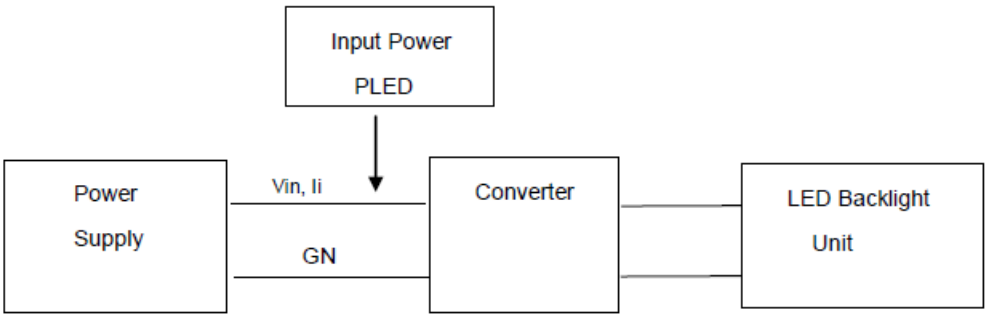
3.2 Backlight Unit

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

Symbol	Parameter		Min.	Typ.	Max.	Unit	Note
LED_Vin	Converter Power Supply Voltage		10.8	12.0	13.2	V	
Ii	Converter Power Supply Current		0.8	1.0	1.2	A	@LED_Vi=12V (Duty 100%)
Iirsh	Converter Input Rush Current		--	--	3	A	@ LED_Vin rising=1ms
P_{LED}	BLU Power consumption		--	12	--	W	@LED_Vi=12V (Duty 100%)
LED_EN	EN Control Level	Backlight on	2.0	5	5.5	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 estimated data and defined as the time when it continues to operate under the conditions at Ta = 25±2℃ and Duty 100% until the brightness becomes ≦ 50% of its original value. Operating LED under high temperature environment will reduce life time and lead to color shift.



4. SIGNAL CHARACTERISTICS

4.1 Interface Timing

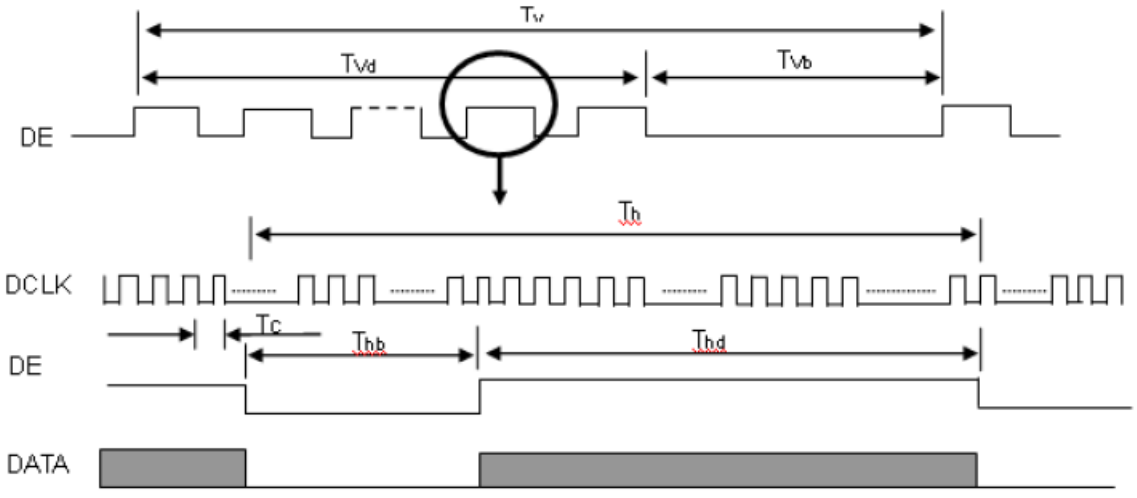
4.1.1 Timing Characteristics:

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	(60)	70.93	(75)	MHZ	
	Period	Tc	--	14.1	--	ns	
	Input cycle to cycle jitter	Trd	-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_{clkin_mod}	Fc*98%	--	Fc*102%	MHz	(5)
	Spread spectrum modulation frequency	F_{SSM}	--	--	200	KHz	
Vertical Display Term	Frame Rate	Fr	(50)	60	60	Hz	Tv=Tvd+Tvb
	Total	Tv	(1090)	1110	(1130)	Th	--
	Display	Tvd	1080	1080	1080	Th	--
	Blank	Tvb	Tv-Tvd	30	Tv-Tvd	Th	--
Horizontal Display Term	Total	Th	(1050)	1065	(1075)	Tc	Th=Thd+Thb
	Display	Thd	960	960	960	Tc	--
	Blank	Thb	Th-Thd	105	Th-Thd	Tc	--

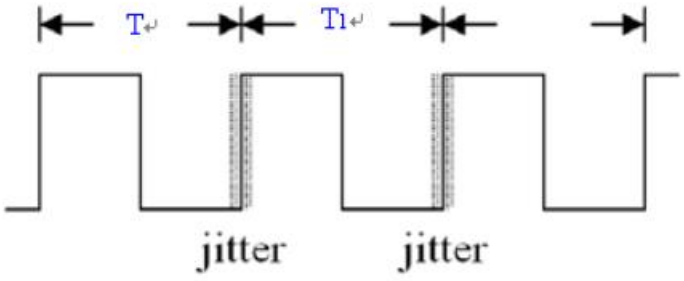
Note (1) Because this module is operated by DE only mode. Hsync and Vsync input signals are ignored.

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

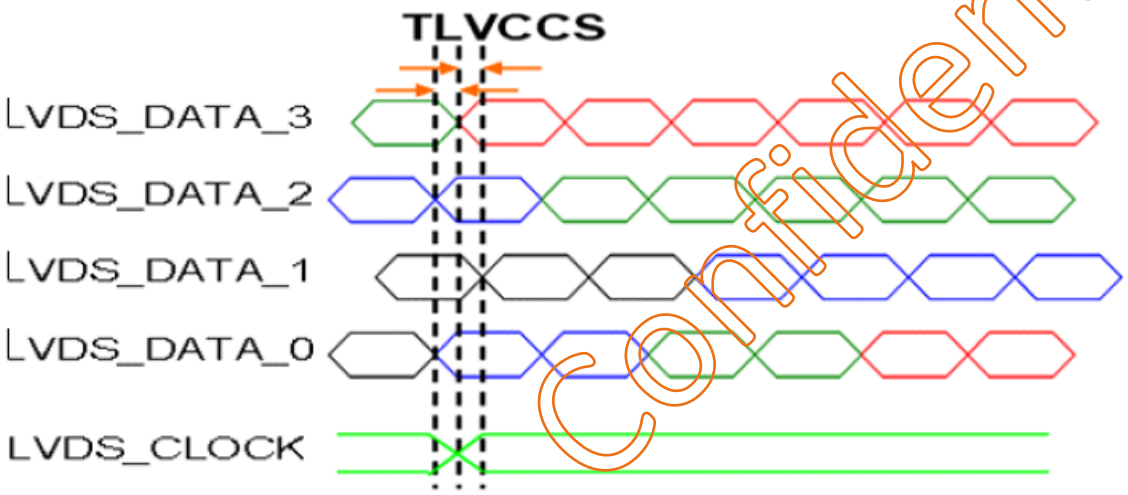
INPUT SIGNAL TIMING DIAGRAM



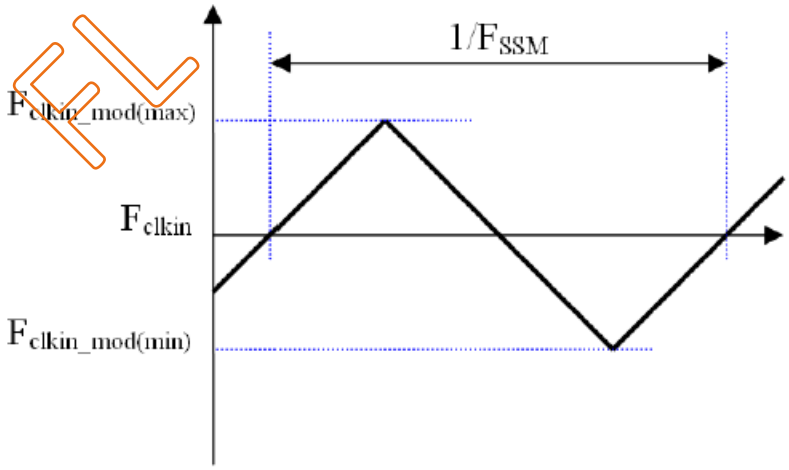
Note (3) The input clock cycle-to-cycle jitter is defined as below figures. Trcl=|T1-T|



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

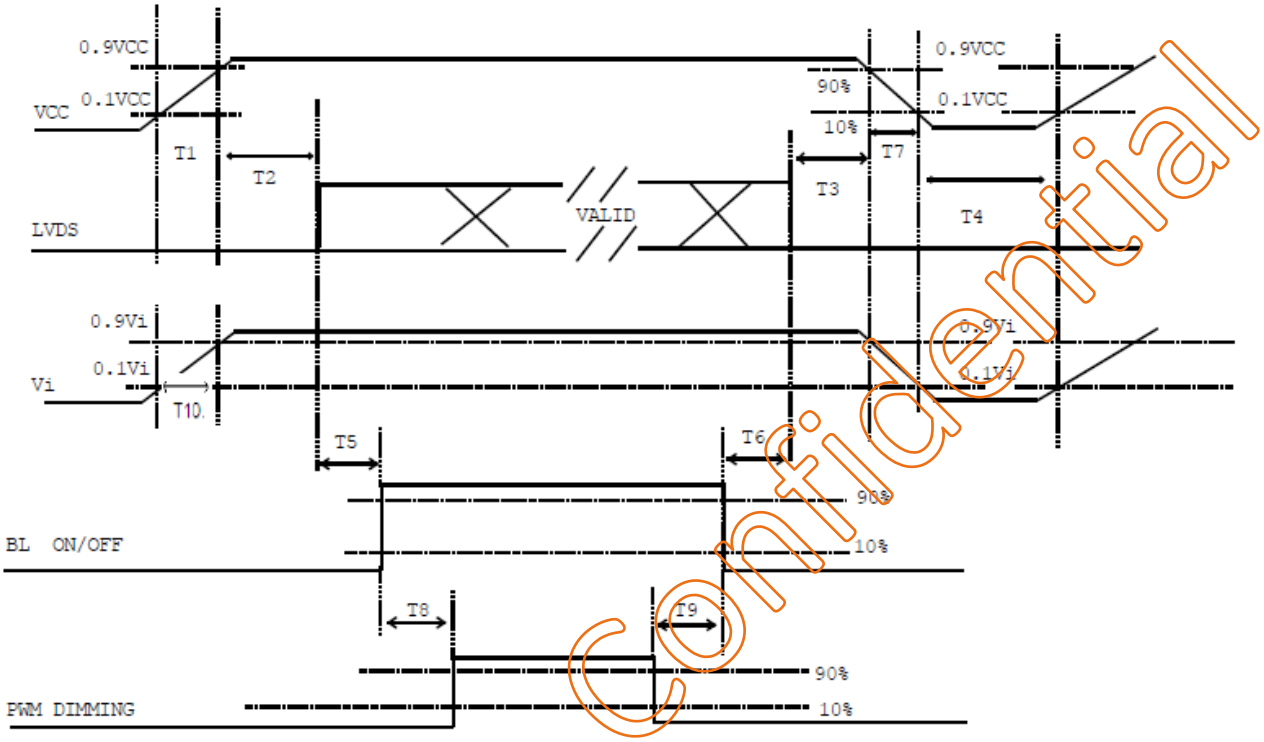


Note (5) The SSCG (Spread spectrum clock generator) is defined as below figures.



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.



Timing specifications:

Parameter	Value			Units
	Min	Typ	Max	ms
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-		ms
T5	450	-		ms
T6	20	-		ms
T7	10	-	300	ms
T8	10	-		ms
T9	10	-		ms
T10	20	-		ms

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.

4.2 LVDS DATA MAPPING TABLE

LVDS Channel O0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	OG0	OR5	OR4	OR3	OR2	OR1	OR0
LVDS Channel O1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	OB1	OB0	OG5	OG4	OG3	OG2	OG1
LVDS Channel O2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	OB5	OB4	OB3	OB2
LVDS Channel O3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	OB7	OB6	OG7	OG6	OR7	OR6
LVDS Channel E0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	EG0	ER5	ER4	ER3	ER2	ER1	ER0
LVDS Channel E1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	EB1	EB0	EG5	EG4	EG3	EG2	EG1
LVDS Channel E2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	EB5	EB4	EB3	EB2
LVDS Channel E3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	EB7	EB6	EG7	EG6	ER7	ER6

4.2.1 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

5. INTERFACE PIN DESCRIPTION

5.1 LCM Connector PIN Assignment

	Symbol	Description	Note
1	LED_Vcc	Vi Power supply: +12V	-
2	LED_Vcc	Vi Power supply: +12V	-
3	LED_Vcc	Vi Power supply: +12V	-
4	LED_Vcc	Vi Power supply: +12V	-
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 3.3V	
12	LCD_Vcc	LCD logic and driver power 3.3V	-
13	LCD_Vcc	LCD logic and driver power 3.3V	-
14	NC	No connection	-
15	NC	No connection	-
16	NC	No connection	-
17	LCD GND	LCD logic and driver ground	-
18	RXO0-	Negative LVDS differential data input. CHO0(odd)	-
19	RXO0+	Positive LVDS differential data input. CHO0(odd)	-
20	RXO1-	Negative LVDS differential data input. CHO1(odd)	
21	RXO1+	Positive LVDS differential data input. CHO1(odd)	
22	RXO2-	Negative LVDS differential data input. CHO2(odd)	
23	RXO2+	Positive LVDS differential data input. CHO2(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. CHO3(odd)	
29	RXO3+	Positive LVDS differential data input. CHO3(odd)	
30	RXE0-	Negative LVDS differential data input. CHE0 (even)	
31	RXE0+	Positive LVDS differential data input. CHE0 (even)	
32	RXE1-	Negative LVDS differential data input. CHE1 (even)	
33	RXE1+	Positive LVDS differential data input. CHE1 (even)	
34	LCD GND	LCD logic and driver ground	
35	RXE2-	Negative LVDS differential data input. CHE2 (even)	
36	RXE2+	Positive LVDS differential data input. CHE2 (even)	
37	RXEC-	Negative LVDS differential clock input (even)	

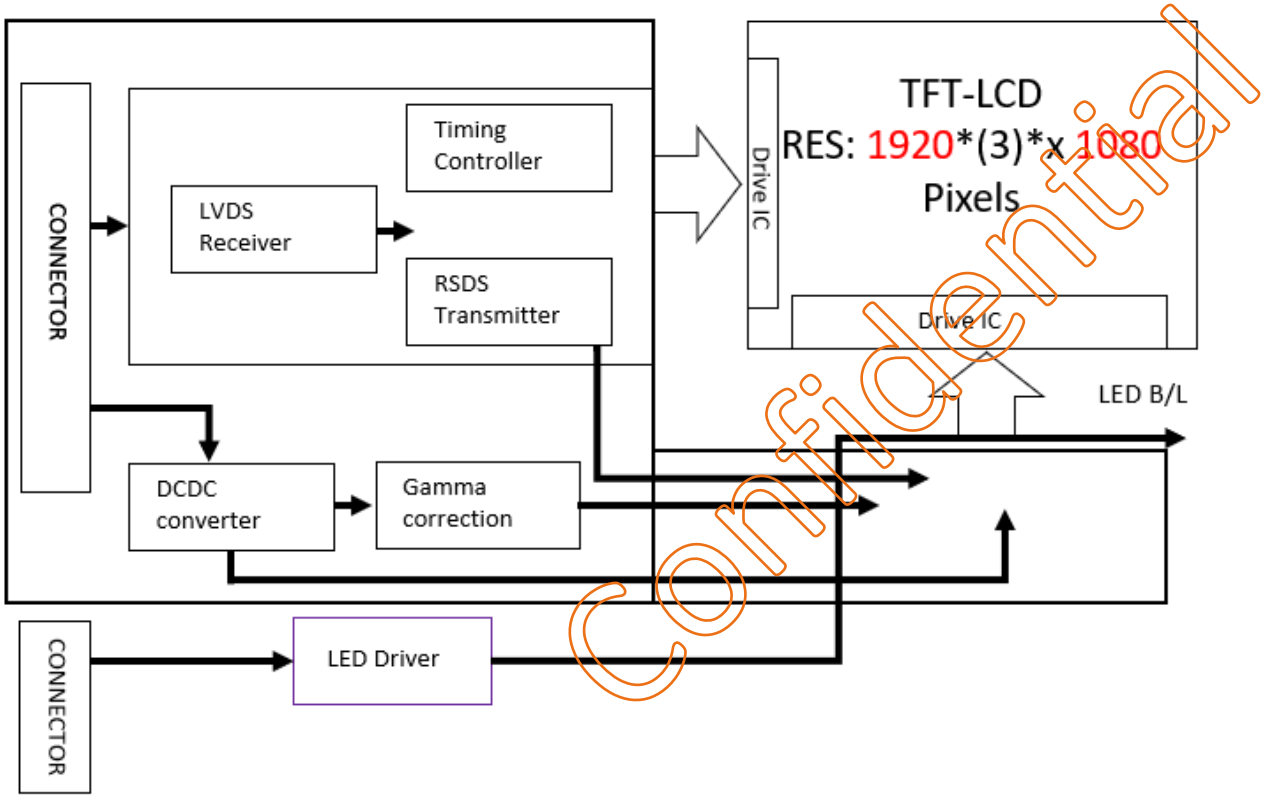
38	RXEC+	Positive LVDS differential clock input (even)	
39	RXE3-	Negative LVDS differential data input. CHE3 (even)	
40	RXE3+	Positive LVDS differential data input. CHE3 (even)	

Note (1) Connector Part no.: I-PEX20455-040E-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.

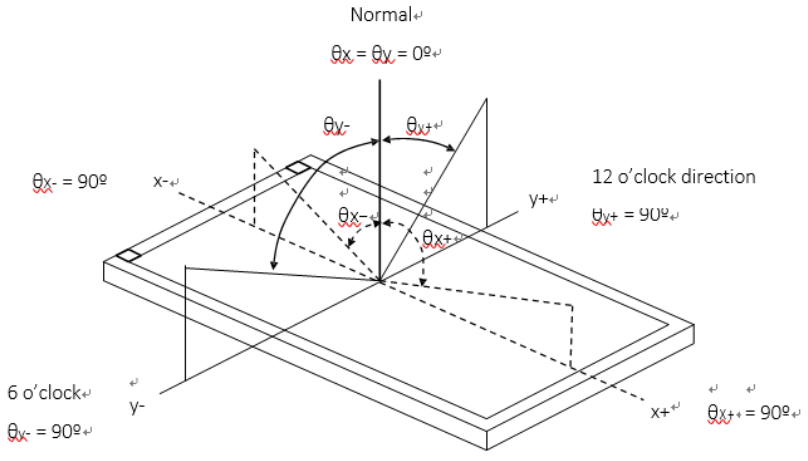
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_X=0°, θ_Y =0° Viewing angle at normal direction	600	800		-	(2)(5)
Response Time		T_R		-	13	18	ms	(3)
		T_F		-	12	17	ms	
Center Luminance of White		LC		360	450	-	cd/m2	(4)(5)
White Variation		δW		70	--	--	%	(5)(6)
Chromaticity	Red	Rx		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	80	85	-	Deg.	(1)(5)
		θ_X-		80	85	-		
	Vertical	θ_Y+		80	85	-		
		θ_Y-		80	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

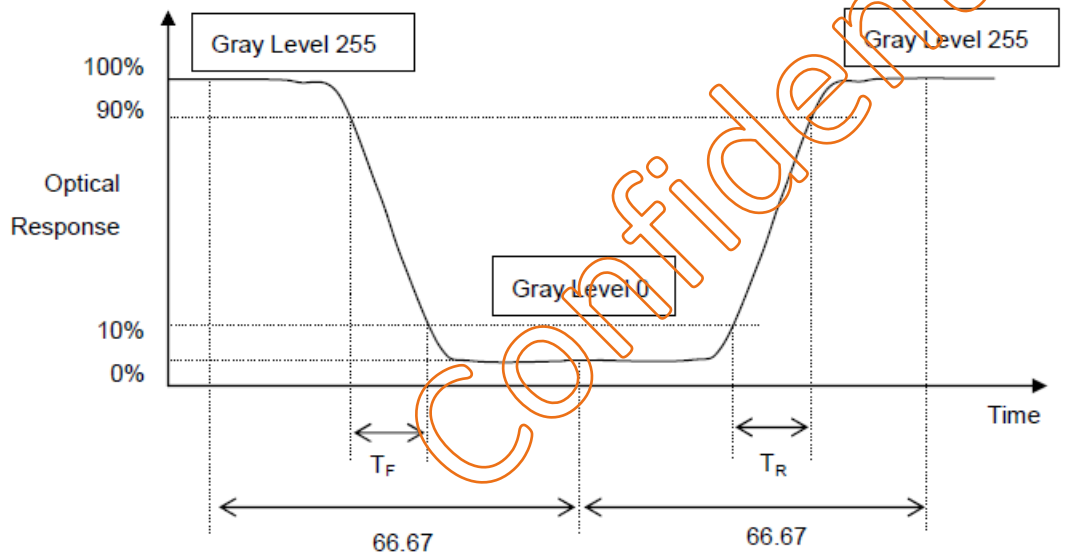


Note 2: Definition of Contrast Ratio (CR)

Measure the viewing angle of 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:

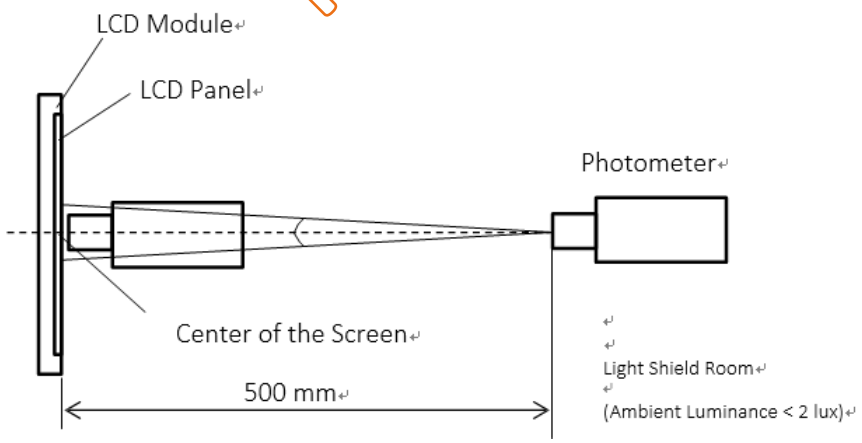
The response time is set initially by defining the "Rising Time (T_R)" and the "Falling Time (T_F)" respectively. Please refer the figure to the followings:



Note 4: Definition of Brightness (L)

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

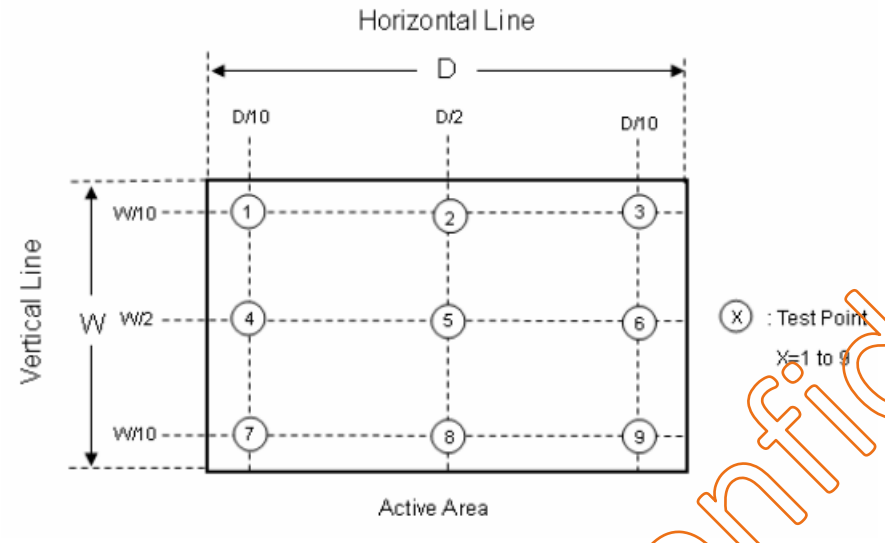
Note 5: The method of optical measurement:



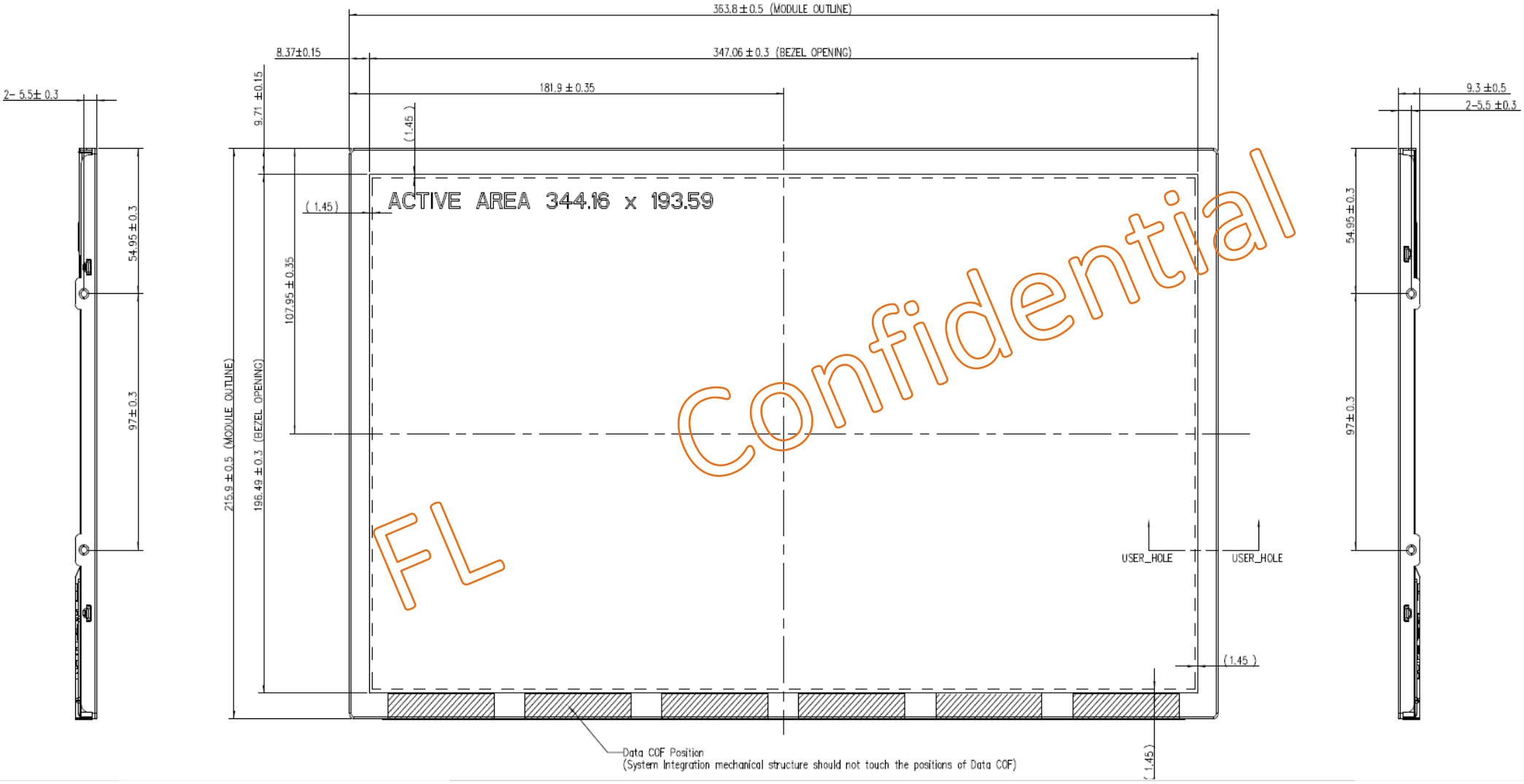
Note 6: Definition of White Variation (δW):

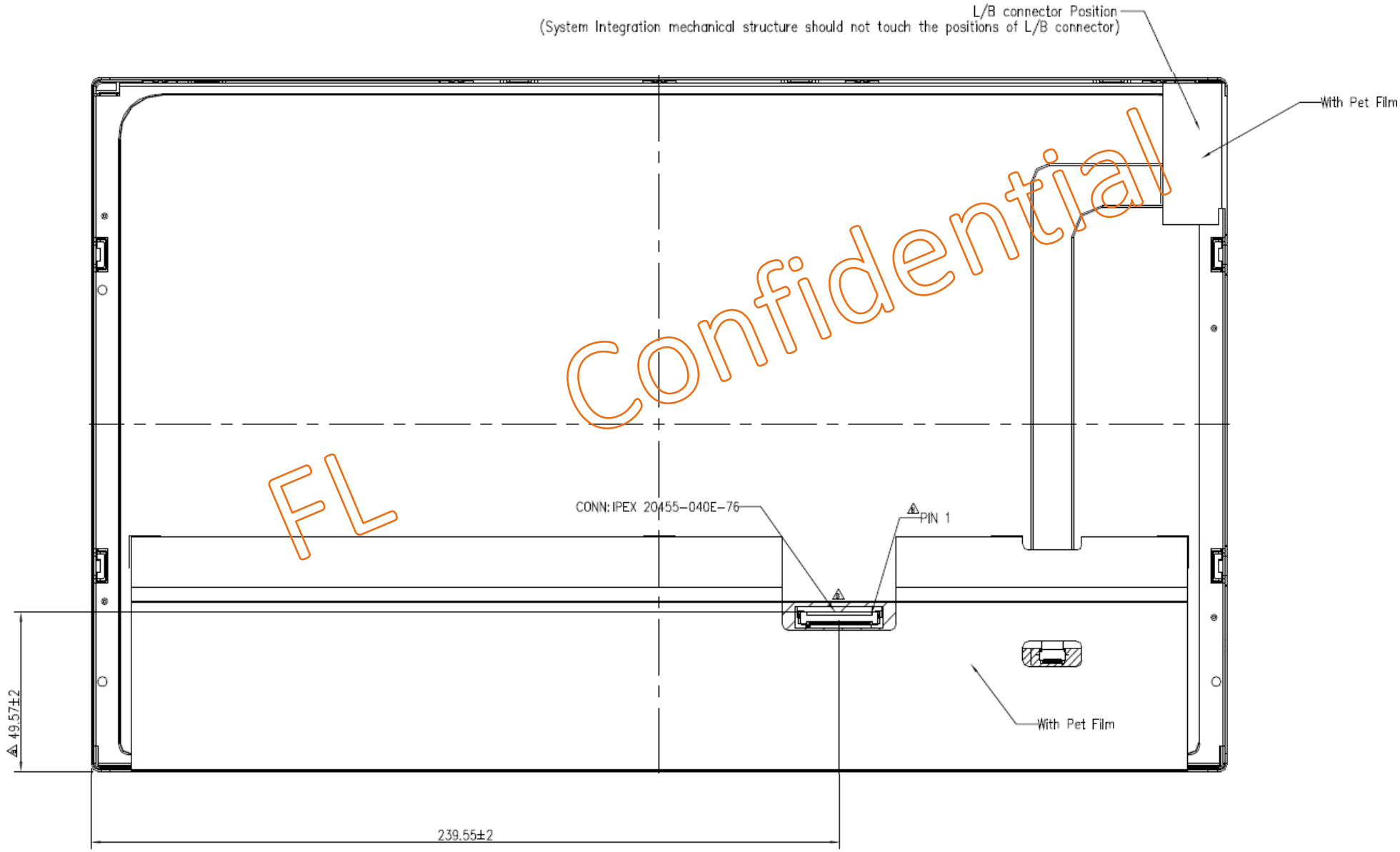
Measure the luminance of gray level 255 at 5 points

δW = Maximum [L (1), L (2), L (3), L (4)~ L (9)] / Minimum [L (1), L (2), L (3), L (4)~ L (9)]



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