TFT DISPLAY SPECIFICATION

WINSTAR Display Co.,Ltd.

華凌光電股份有限公司

Winstar Display Co., LTD
華凌光電股份有限公司
WEB: https://www.winstar.com.tw E-mail: sales@winstar.com.tw

SPECIFICATION

CUSTOMER : _____

MODULE NO.: WF150ATYAMLNN0#

APPROVED BY: **(FOR CUSTOMER USE ONLY)**	**PCB VERSION:** **DATA:**

SALES BY	APPROVED BY	CHECKED BY	PREPARED BY
			朱惠菁
ISSUED DATE: 2017/08/16			

TFT Display Inspection Specification: https://www.winstar.com.tw/technology/download.html
Precaution in use of TFT module: https://www.winstar.com.tw/technology/download/declaration.html

Winstar Display Co., LTD 華凌光電股份有限公司	MODLE NO：
RECORDS OF REVISION	**DOC. FIRST ISSUE**

VERSION	DATE	REVISED PAGE NO.	**SUMMARY**
0	2017/08/16		First issue

Contents

1.Module Classification Information

W	F	150	A	T	Y	A	M	L	N	N	0	#
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬

①	Brand：WINSTAR DISPLAY CORPORATION		
②	Display Type：F→TFT Type, J→Custom TFT		
③	Display Size：15.0” TFT		
④	Model serials no.		
⑤	Backlight Type：	F→CCFL, White S→LED, High Light White	T→LED, White Z→Nichia LED, White
⑥	LCD Polarize Type/ Temperature range/ Gray Scale Inversion Direction	A→Transmissive, N.T, IPS TFT C→Transmissive, N. T, 6:00 ; F→Transmissive, N.T,12:00 ; I→Transmissive, W. T, 6:00 K→Transflective, W.T,12:00 L→Transmissive, W.T,12:00 N→Transmissive, Super W.T, 6:00	Q→Transmissive, Super W.T, 12:00 R→Transmissive, Super W.T, O-TFT V→Transmissive, Super W.T, VA TFT W→Transmissive, Super W.T, IPS TFT X→Transmissive, W.T, VA TFT Y→Transmissive, W.T, IPS TFT Z→Transmissive, W.T, O-TFT
⑦	A：TFT LCD B：TFT+SCREW HOLES+CONTROL BOARD C：TFT+ SCREW HOLES +A/D BOARD D：TFT+ SCREW HOLES +A/D BOARD+CONTROL BOARD E：TFT+ SCREW HOLES +POWER BOARD		F：TFT+CONTROL BOARD G：TFT+ SCREW HOLES H：TFT+D/V BOARD I：TFT+ SCREW HOLES +D/V BOARD J：TFT+POWER BD

⑧ Resolution:

A	128160	B	320234	C	320240	D	480234	E	480272	F	640480
G	800480	H	1024600	I	320480	J	240320	K	800600	L	240400
M	1024768	N	128128	P	1280800	Q	480800	R	640320	S	480128
T	800320	U	8001280	**V**	176220	W	1280398	X	1024250	Y	1920720
Z	800200	2	1024324	3	7201280	4	19201200	5	1366768	6	1280320

⑨ D: Digital L：LVDS M:MIPI

⑩ Interface:

N	Without control board	A	8Bit	B	16Bit	H	HDMI
I	I2C Interface	R	RS232	S	SPI Interface	U	USB

⑪ TS:

N	Without TS	T	Resistive touch panel	C	Capacitive touch panel (G-F-F)
G	Capacitive touch panel (G-G)	C1	Capacitive touch panel (G-F-F)+OCA		
C2	Capacitive touch panel (G-F-F)+OCR	G1	Capacitive touch panel (G-G)+OCA		
G2	Capacitive touch panel (G-G)+OCR	B	CTP+GG+USB		

⑫	Version: X:Raspberry pi	
⑬	Special Code	#:Fit in with ROHS directive regulations

2.Summary

WF150A is a 15.0” TFT Liquid Crystal Display IAV module with LED Backlight units and 20 pins LVDS interface. This module supports 1024 x 768 XGA mode and can display 16.2M/262k colors.

The PSWG is to establish a set of displays with standard mechanical dimensions and select electrical interface requirements for an industry standard 15.0” XGA LCD panel and the LED driving device for Backlight is built in PCBA.

3.General Specifications

Item	Dimension	Unit
Size	15.0	inch
Dot Matrix	1024 x RGB x 768 (TFT)	dots
Module dimension	326.5 x 253.5 x9.1	mm
Active area	304.1 x 228.1	mm
Dot pitch	0.297 x 0.297	mm
LCD type	TFT, Normally Black, Transmissive	
Viewing Angle	88/88/88/88	
Backlight Type	LED,Normally White	
Interface	LVDS	
With /Without TP	Without TP	
Surface	Anti-Glare	

*Color tone slight changed by temperature and driving voltage.

4.Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	TOP	-20	—	+70	℃
Storage Temperature	TST	-30	—	+70	℃

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

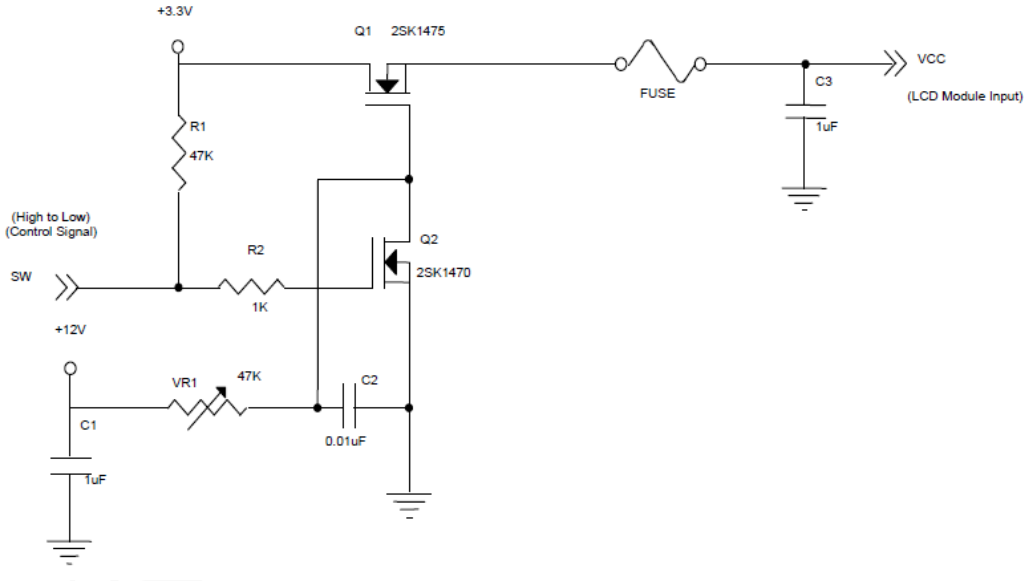
1. Temp. ≦60℃, 90% RH MAX. Temp.＞60℃, Absolute humidity shall be less than 90% RH at 60℃

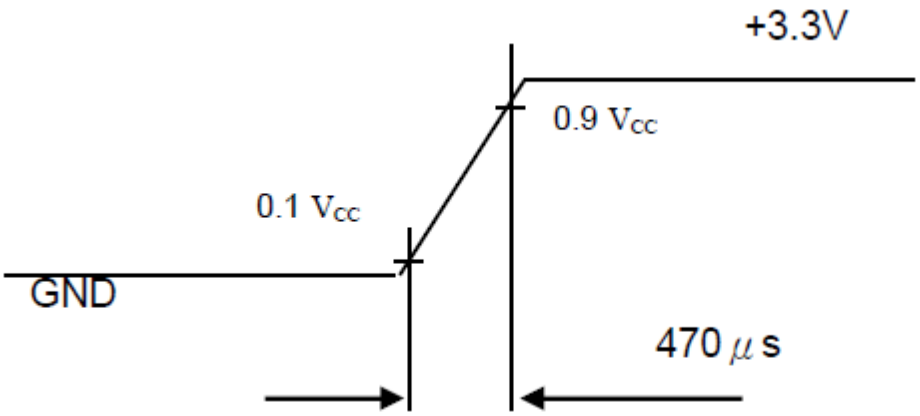
5.Electrical Characteristics

5.1. TFT LCD MODULE

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_C	3.0	3.3	3.6	V	-
Ripple Voltage		V_{RP}	-	-	100	mVp-	
Rush Current		I_{RUS}	-	-	(2.0)	A	(2
Power Supply Current	White	Icc	-	(800)	(960)	mA	(3)a
	Black		-	(670)	(800)	mA	(3)b
LVDS differential input voltage		Vid	200	-	600	mV	
LVDS common input voltage		Vi	1.0	1.2	1.4	V	
Differential Input Voltage for LVDS	"H" Level	V_I	-	-	100	mV	-
	"L" Level	V_{IL}	-100	-	-	mV	-
Terminating Resistor		RT	-	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 V_{DD} =3.3V, Ta = 25 ± 2 ℃, DC Current and f_V = 60 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

Active Area

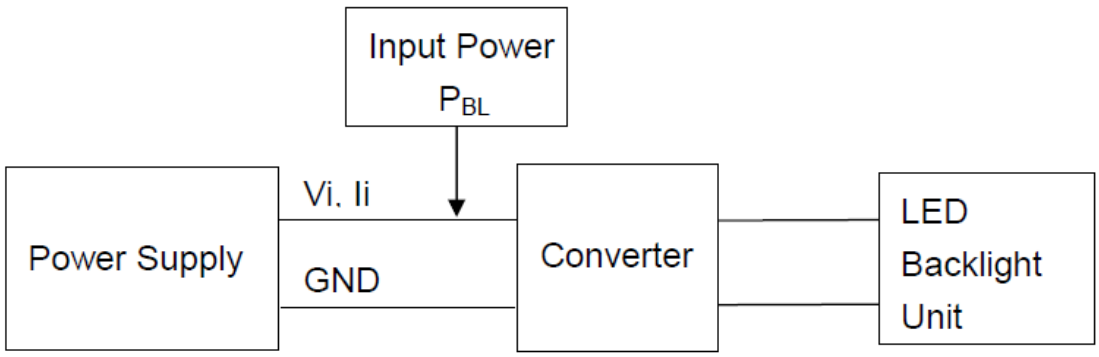
b. Black Pattern

Active Area

5.2. BACKLIGHT UNIT

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Converter Power Supply Voltage		Vi	10.8	12.0	13.2	V	
Converter Power Supply Current		Ii	(0.36)	(0.46)	(0.56)	A	@ Vi = 12V (Duty 100%)
Backlight Power Consumption		PBL	-	(5.52)	(6.72)	W	@ Vi = 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
PWM Dimming Control Frequency		fPWM	190	200	20k	Hz	(2)
LED Life Time		LL	(50,000)	(70,000)	-	Hrs	(3)

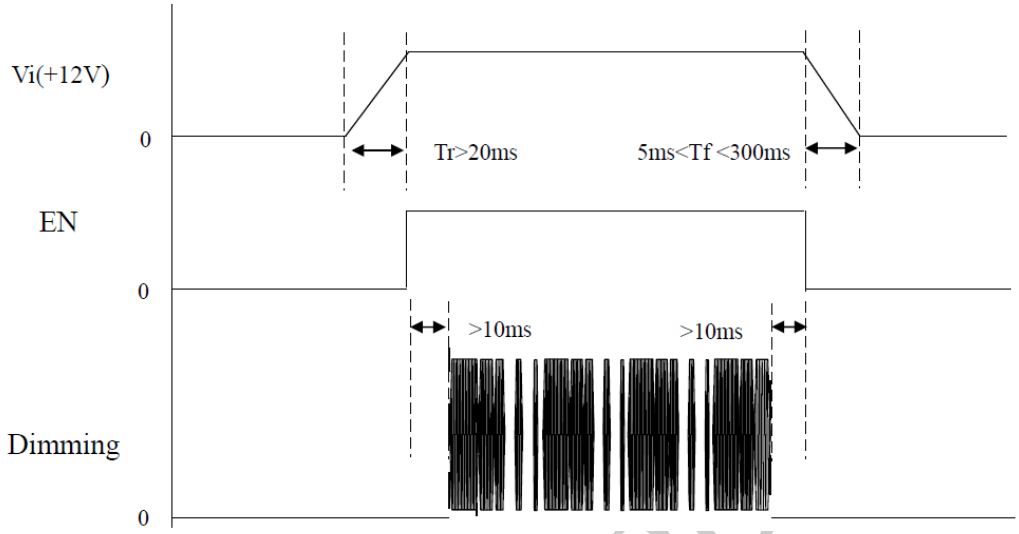
Note (1) LED current is measured by utilizing a high frequency current meter as shown below:



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

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 ℃ 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.

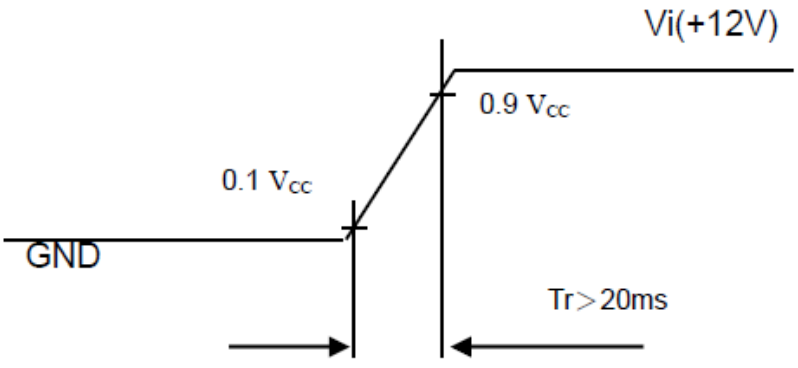
Power sequence and control signal timing are shown in the following figure



Note： While system is turned ON or OFF, the power sequences must follow as below descriptions Turn ON sequence: Vi(+12V) → EN → Dimming

Turn OFF sequence: Dimming → EN → Vi(+12V)

Note (4)



6.Interface timing

6.1. INPUT SIGNAL TIMING SPECIFICATIONS

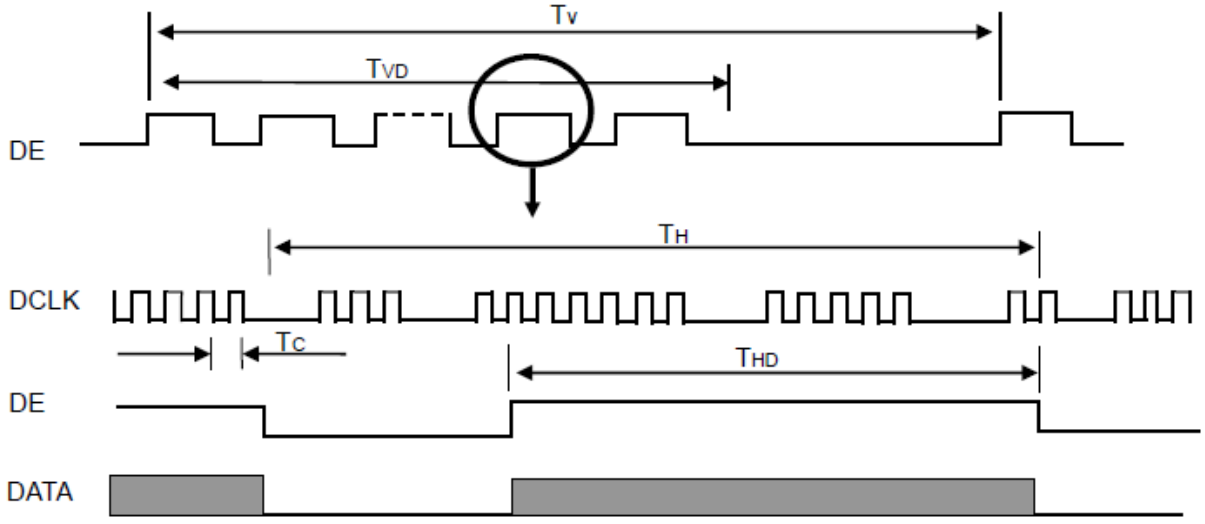
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	53.35	65	80	MHz	-
	Period	Tc	12.5	15.38	18.75	ns	
	Input cycle to cycle jitter	T_{rcl}	---	---	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	--	60	--	Hz	Tv=Tvd+Tvb
	Total	Tv	780	806	1200	Th	-
	Active Display	Tvd	768	768	768	Th	-
	Blank	Tvb	Tv-Tvd	38	Tv-Tvd	Th	-
Horizontal Display Term	Total	Th	1140	1344	1600	Tc	Th=Thd+Thb
	Active Display	Thd	1024	1024	1024	Tc	-
	Blank	Thb	Th-Thd	320	Th-Thd	Tc	-

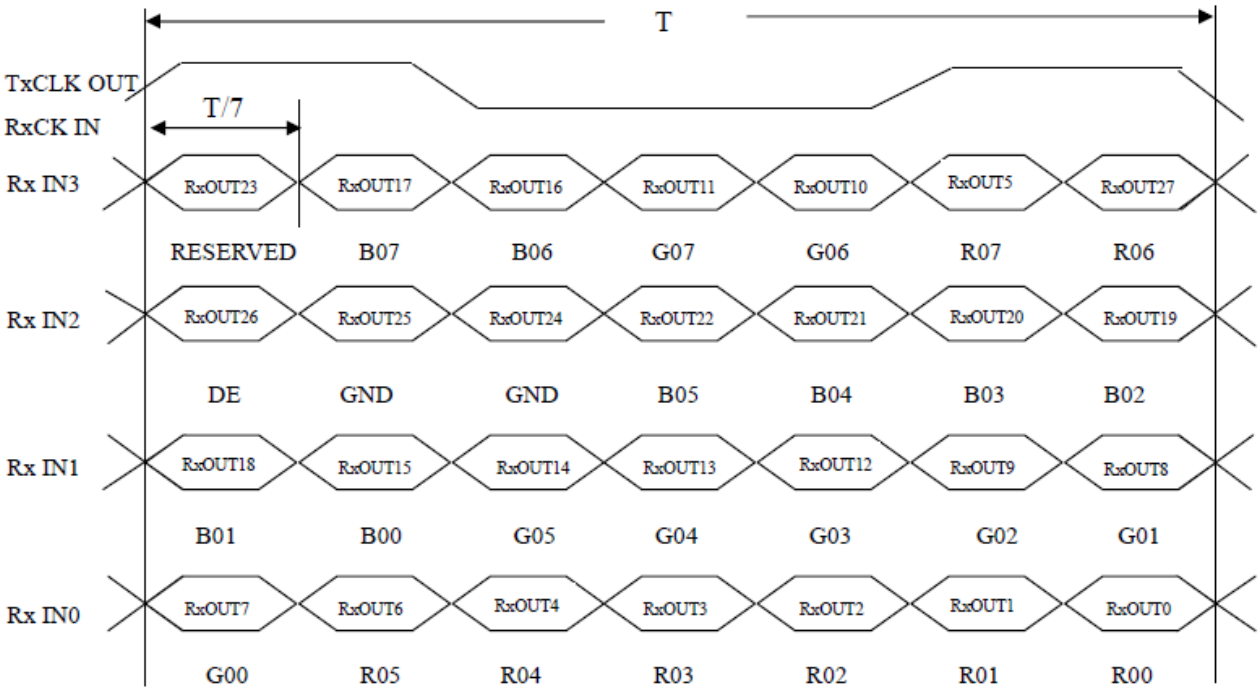
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

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

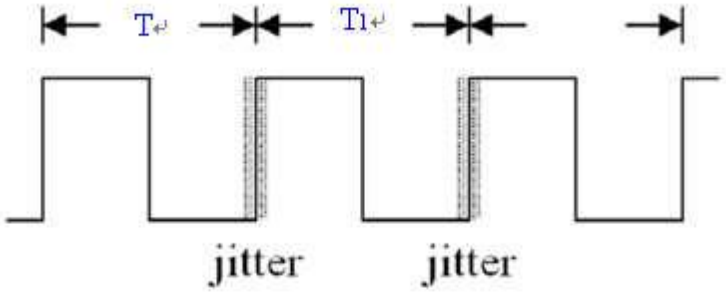
INPUT SIGNAL TIMING DIAGRAM



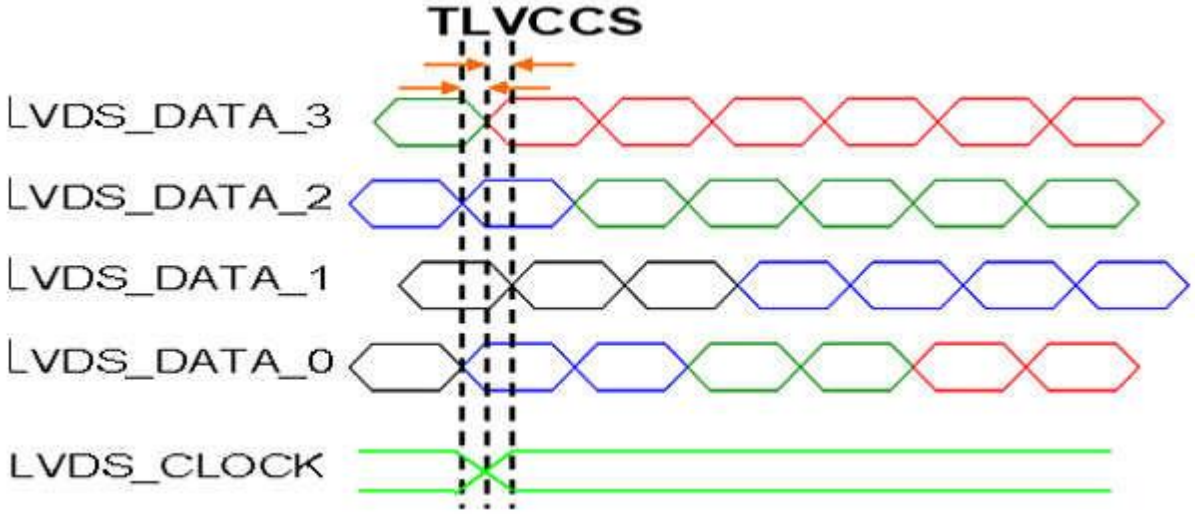
TIMING DIAGRAM of LVDS



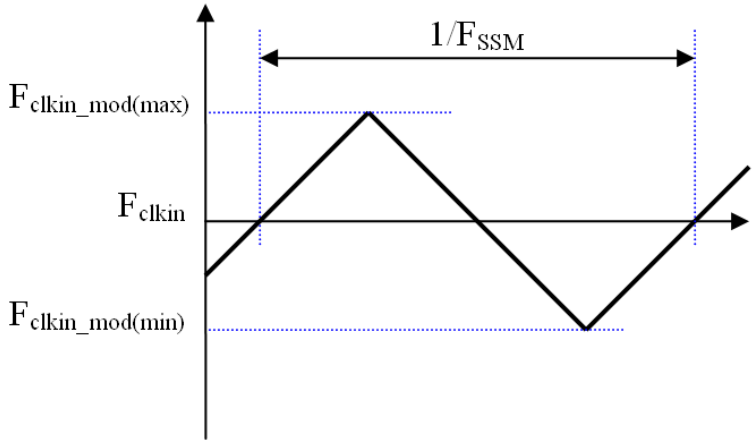
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T1 – TI



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

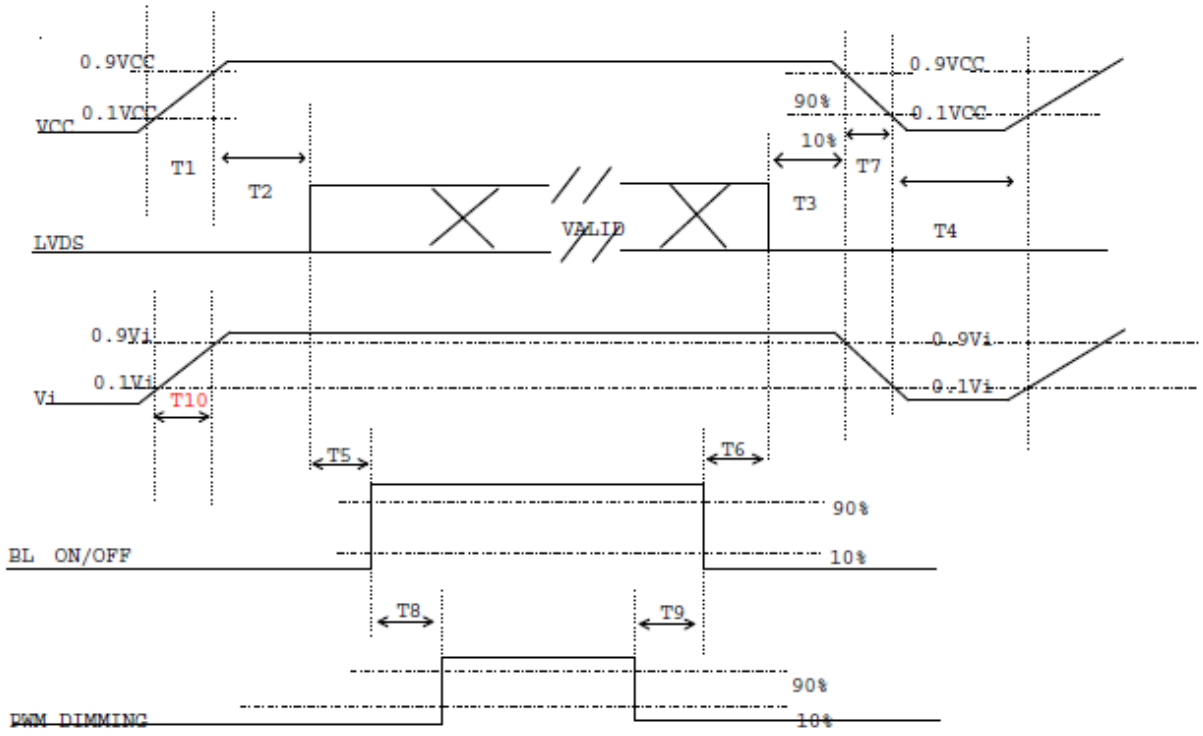


Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



6.2. 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.



Power ON/OFF sequence

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 0 V.
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	Typ	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			ms

SCANNING DIRECTION

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

Fig.1 Normal Scan Fig.2 Reverse Scan

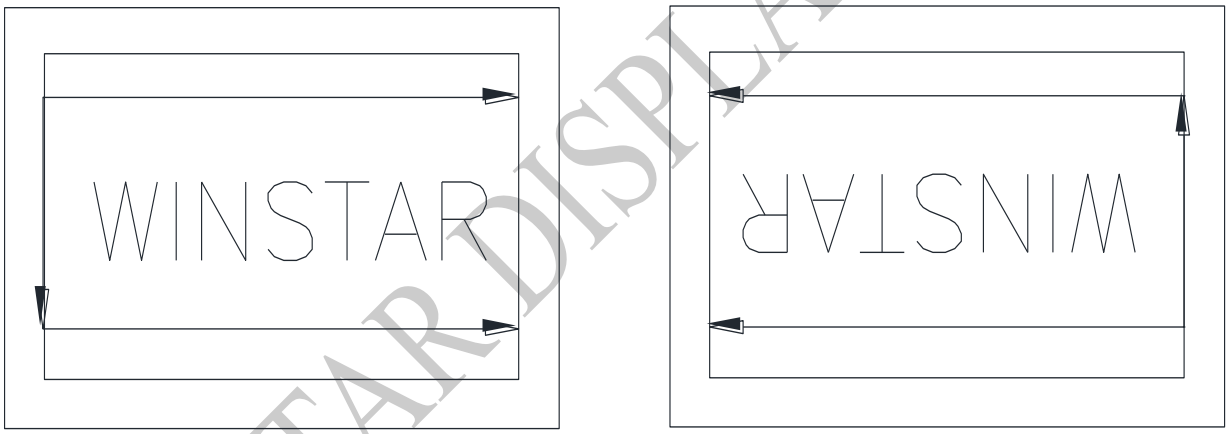


Fig. 1 Normal scan (pin 4, LR/UD = High or NC)
Fig. 2 Reverse scan (pin 4, LR/UD = Low)

7.Optical Characteristics

Item		Symbol	Condition.	Min	Typ.	Max.	Unit	Remark
Response time		Tr	θ=0°、Φ=0°	-	16	-	.ms	Note 3,5
		Tf		-	7	-	.ms	
Contrast ratio		CR	At optimized viewing angle	1300	2000	-	-	Note 4,5
Color Chromaticity	White	Wx	θ=0°、Φ=0	0.263	0.313	0.363		Note 2,6,7
		Wy		0.279	0.329	0.379		
Viewing angle	Hor.	ΘR	CR≧10	80	88	-	Deg.	Note 1
		ΘL		80	88	-		
	Ver.	ΦT		80	88	-		
		ΦB		80	88	-		
Brightness		-	-	240	300	-	cd/m^2	Center of display

Ta=25±2℃

Note 1: Definition of viewing angle range

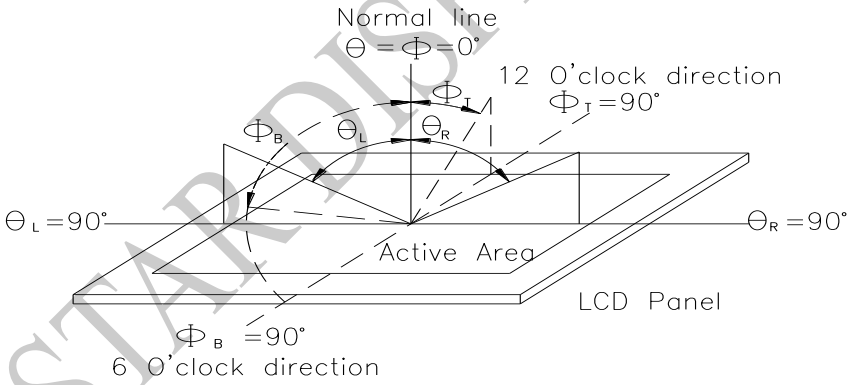


Fig.7.1. Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7orBM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

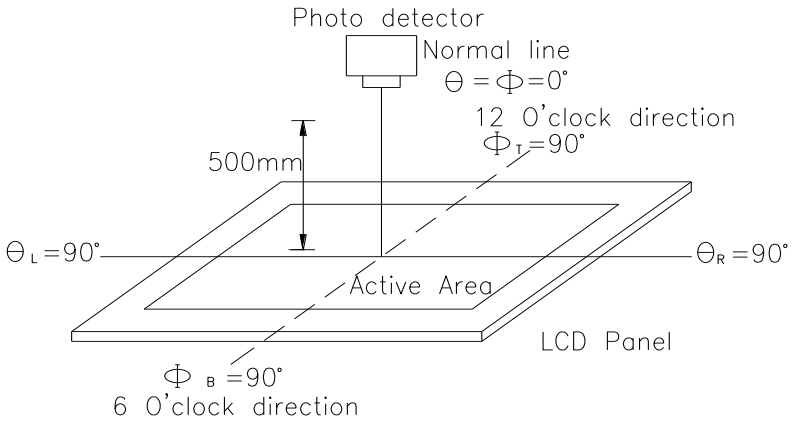
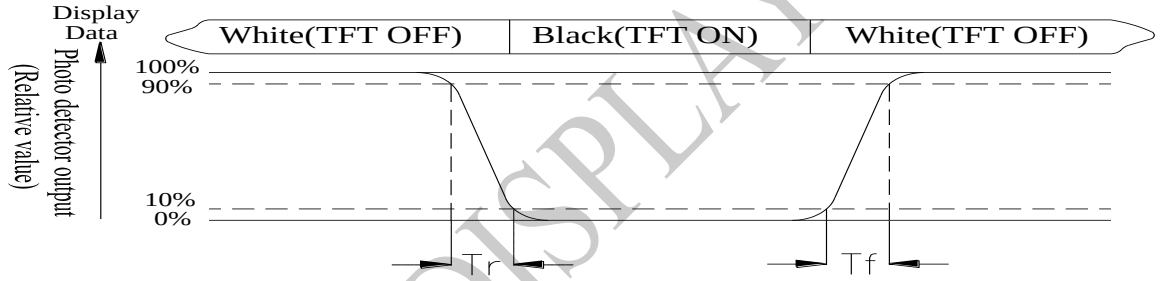


Fig. 7.2. Optical measurement system setup

Note 3: Definition of Response time:
The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time, Tr, is the time between photo detector output intensity changed from 90%to 10%. And fall time, Tf, is the time between photo detector output intensity changed from 10%to 90%



Note 4: Definition of contrast ratio:
The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: White Vi = Vi50 ± 1.5V
Black Vi = Vi50 ± 2.0V
“±” means that the analog input signal swings in phase with VCOM signal.
“±” means that the analog input signal swings out of phase with VCOM signal.
The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 6: Definition of color chromaticity (CIE 1931)
Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

8.Interface

8.1. LCM PIN Definition

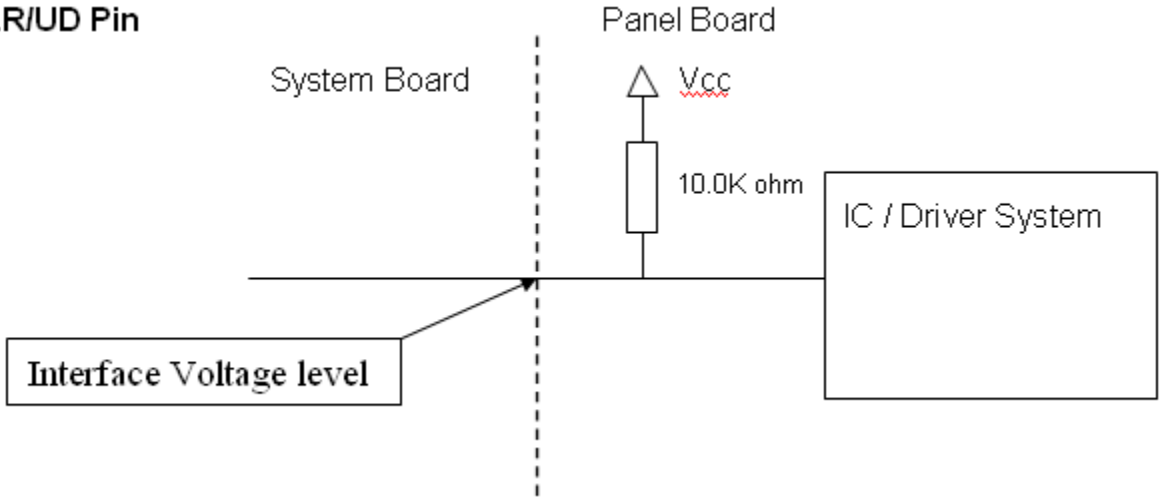
Pin No.	Symbol	Function	Polarity	Note
1	VCC	Power Supply +3.3V(typical)		
2	VCC	Power Supply +3.3V(typical)		
3	NC	No Conncetion (Reserve for INX test)		
4	LR/UD	Reverse Scan Control H or NC = Normal Mode. L = Horizonta/ Vertical Reverse Scan.		
5	RX0-	LVDS Differential Data Input	Negative	
6	RX0+	LVDS Differential Data Input	Positive	
7	GND	Ground		
8	RX1-	LVDS Differential Data Input	Negative	
9	RX1+	LVDS Differential Data Input	Positive	
10	NC	No Conncetion (Reserve for INX test)		
11	RX2-	LVDS Differential Data Input	Negative	
12	RX2+	LVDS Differential Data Input	Positive	
13	GND	Ground		
14	RXCLK-	LVDS Differential Data Input	Negative	
15	RXCLK+	LVDS Differential Data Input	Positive	
16	GND	Ground		
17	RX3-	LVDS Differential Data Input	Negative	
18	RX3+	LVDS Differential Data Input	Positive	
19	NC	No Conncetion (Reserve for INX test)		
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.: Cvilux CID520D1HR0-NH or equivalent.

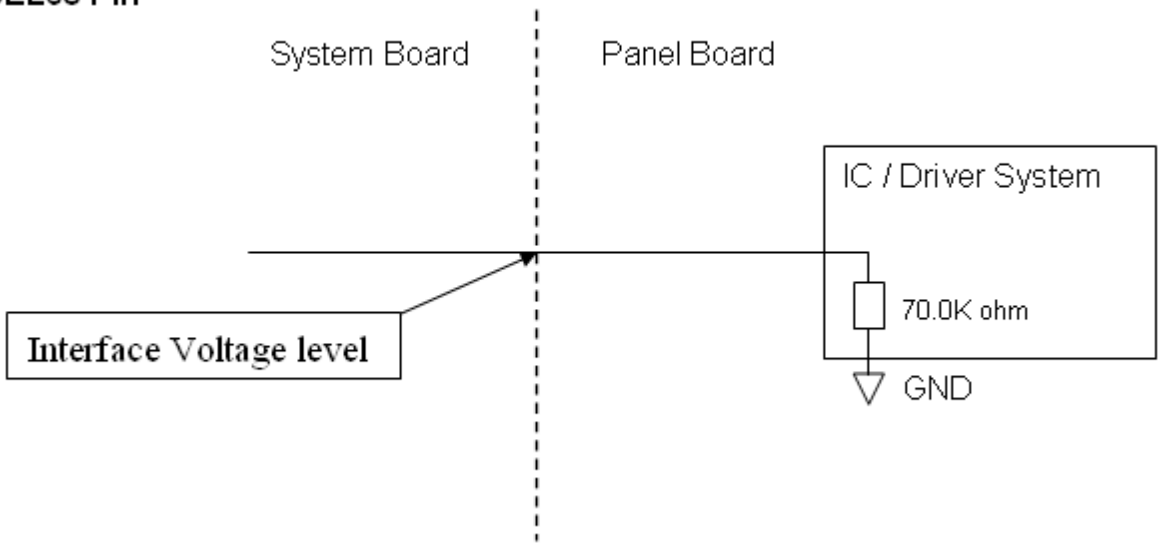
Note (2) User's connector Part No.: Entery H204K-D20N-12B or equivalent.

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

LR/UD Pin



SEL68 Pin



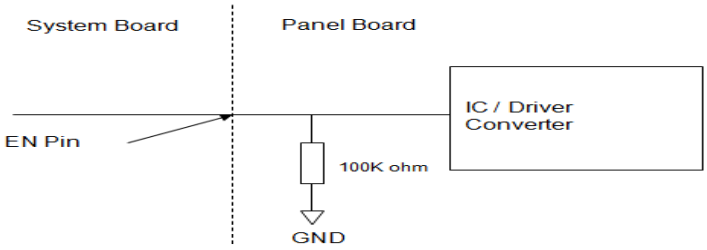
8.2. BACKLIGHT UNIT(Converter connector pin)

Pin	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: 3.3VDC, Lo: 0VDC)
5	NC	Not Connect	

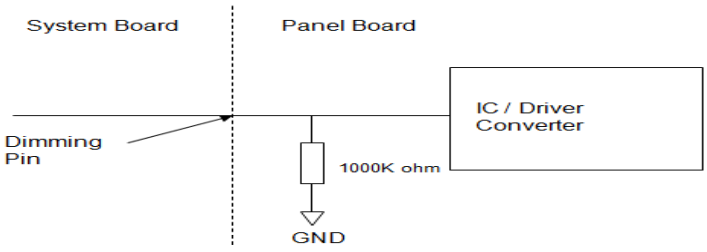
Note (1) Connector Part No.: CI4205-M2HRP-NH (Cvilux) or equivalent.

Note (2) User's connector Part No.: H208K-D05N-22B (Entery) or equivalent

EN Pin



Dimming Pin



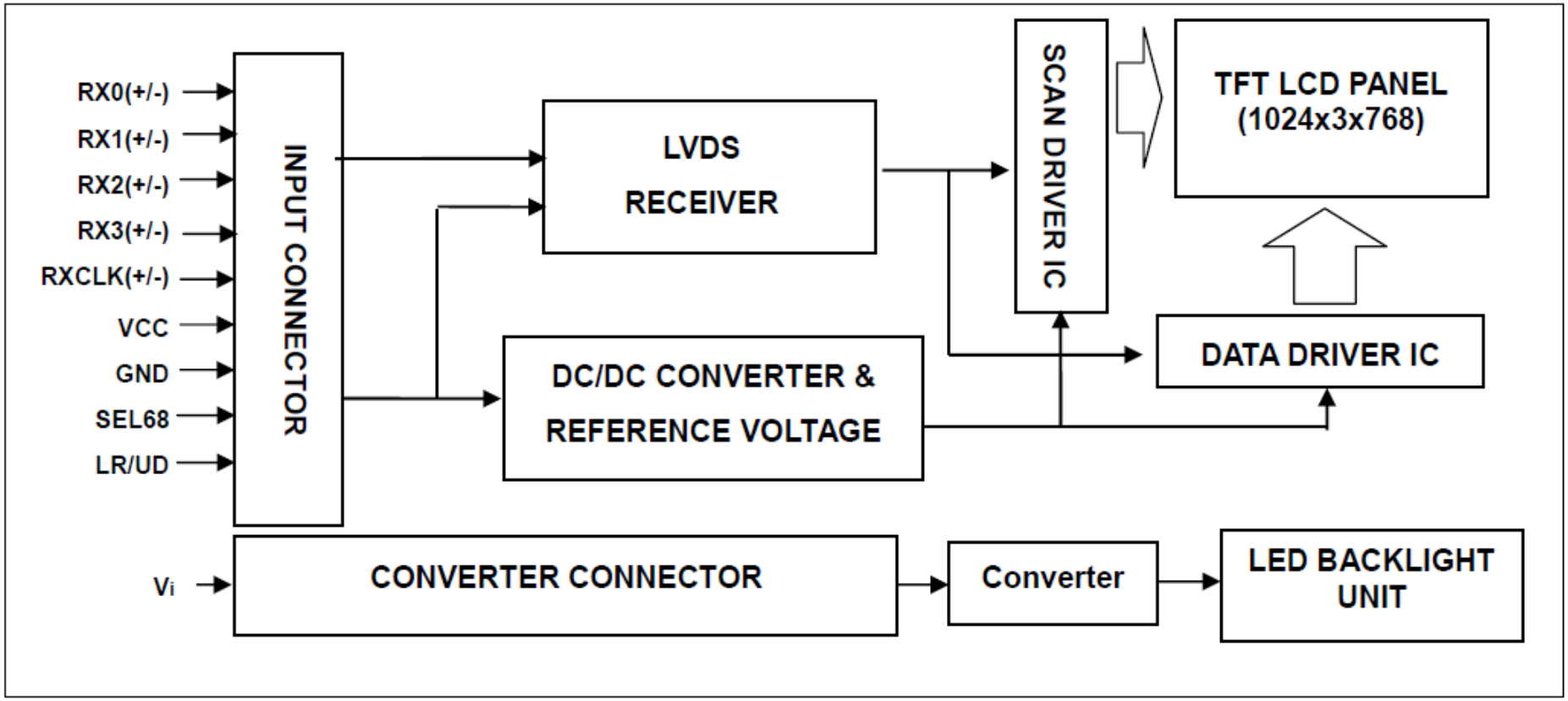
8.3. COLOR DATA INPUT ASSIGNMENT

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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(252)	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(252)	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(252)	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(252)	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(252)	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(252)	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(252)	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(252)	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(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

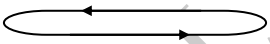
Note (1) 0: Low Level Voltage, 1: High Level Voltage

9.Block Diagram



10.Reliability

Content of Reliability Test (Wide temperature, -20℃~70℃)

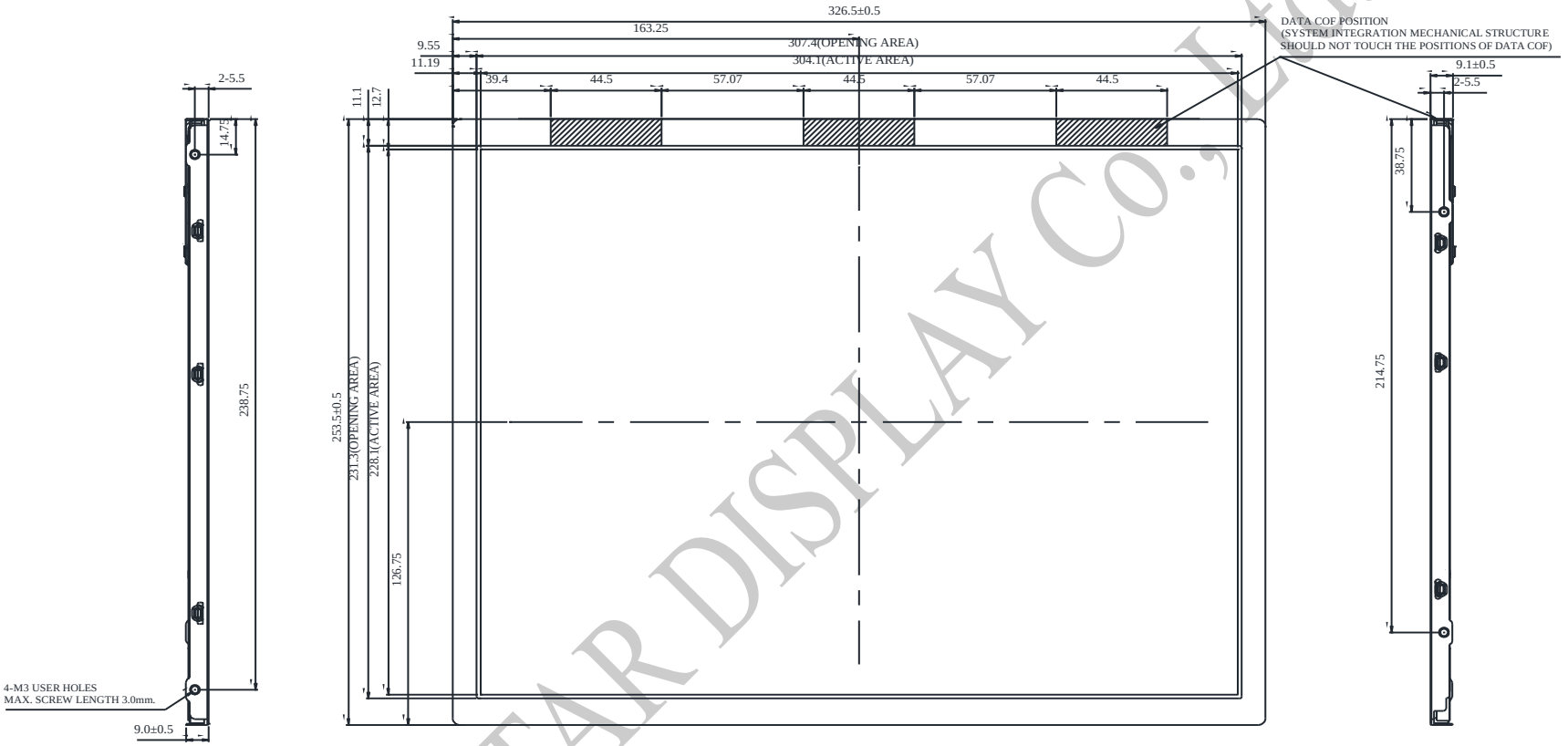
Environmental Test			
Test Item	**Content of Test**	**Test Condition**	**Note**
High Temperature storage	Endurance test applying the high storage temperature for a long time.	70℃ 200hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30℃ 200hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 200hrs	———
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 200hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60℃,90%RH max	60℃,90%RH 96hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation -20℃ 25℃ 70℃  30min 5min 30min 1 cycle	-20℃/70℃ 10 cycles	———
Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes	3
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=±600V(contact), ±800v(air), RS=330Ω CS=150pF 10 times	———

Note1: No dew condensation to be observed.

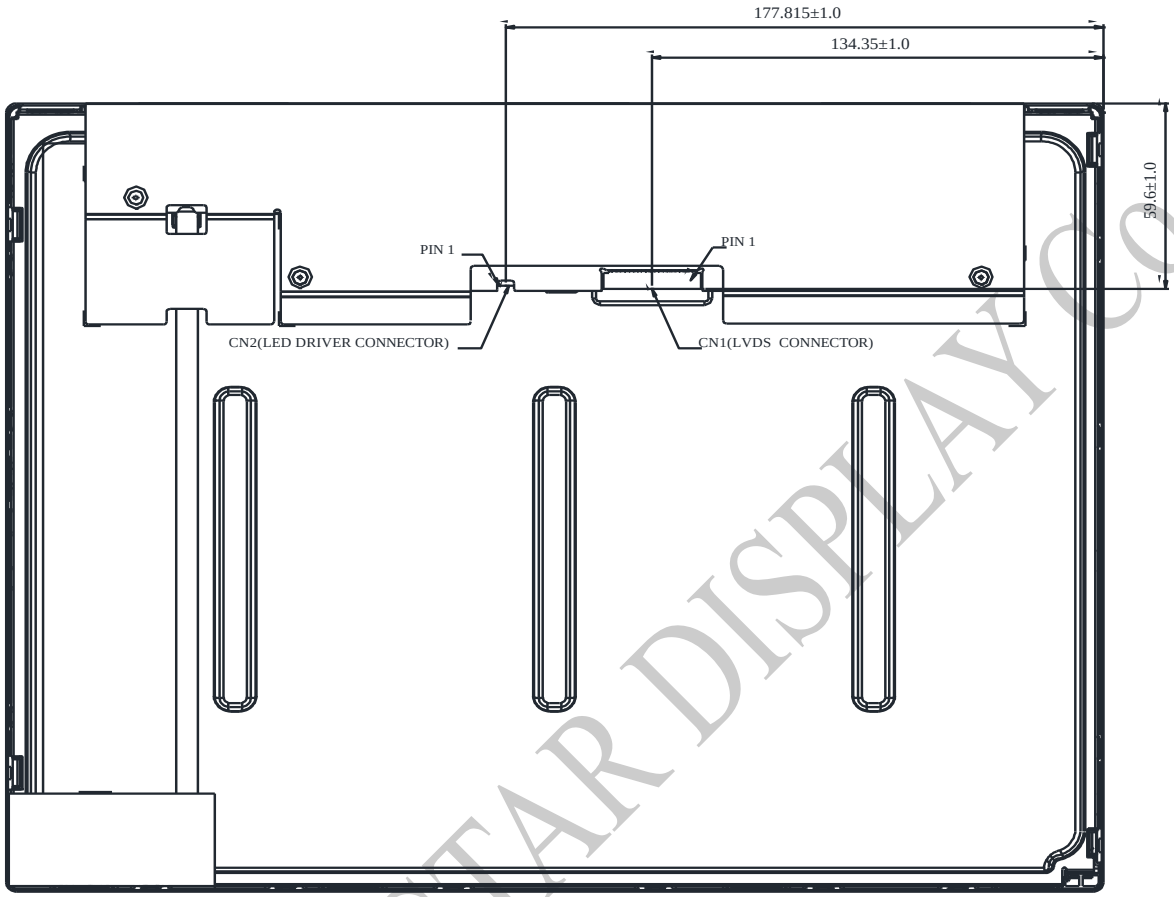
Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.

11.Contour Drawing



The non-specified tolerance of dimension is ±0.3 mm .



CN2

PIN NO.	SYMBOL
1	Vi
2	VGND
3	EN
4	Dimming
5	NC

CN1

PIN NO.	SYMBOL
1	VCC
2	VCC
3	NC
4	LR/UD
5	RX0-
6	RX0+
7	GND
8	RX1-
9	RX1+
10	NC
11	RX2-
12	RX2+
13	GND
14	RXCLK-
15	RXCLK+
16	GND
17	RX3-
18	RX3+
19	NC
20	SEL68

The non-specified tolerance of dimension is ±0.3 mm .