珠海三泰克科技有限公司

San Technology (Zhuhai) Co., Ltd.

SPECIFICATION
FOR
LCD Module

Customer P/N:

Santek P/N: ST1210I2W-RSMLW-C

DOC. Revision: RS01

Customer Approval:

	SIGNATURE	DATE
PREPARED BY	Caihua	2023-8-14
CHECKED BY	Andy Song	2023-8-14
APPROVED BY	Natty Lee	2023-8-14

Document Revision History

Version	Revise Date	Description	Changed by
RS01	2023-8-14	First issue	Caihua

Table of Contents

1. General Specification

1.1 OVERVIEW

The ST1210I2W-RSMLW-C model is a 12.1" TFT-LCD IAV module with a white LED Backlight Unit and a 20-pin 1ch-LVDS interface. This module supports 1024 x 768 XGA mode and displays 262k/16.7M colors. The converter for the Backlight Unit is built in.

1.2 FEATURES

- Wide viewing angle
- High contrast ratio
- XGA (1024 x 768 pixels) resolution
- Wide operating temperature
- DE (Data Enable) mode
- LVDS (Low Voltage Differential Signaling) interface
- Reversible-scan direction
- RoHS Compliance

1.3 APPLICATION

- TFT LCD Monitor
- Industrial Application
- Amusement

1.4 GENERAL SPECIFICATI0NS

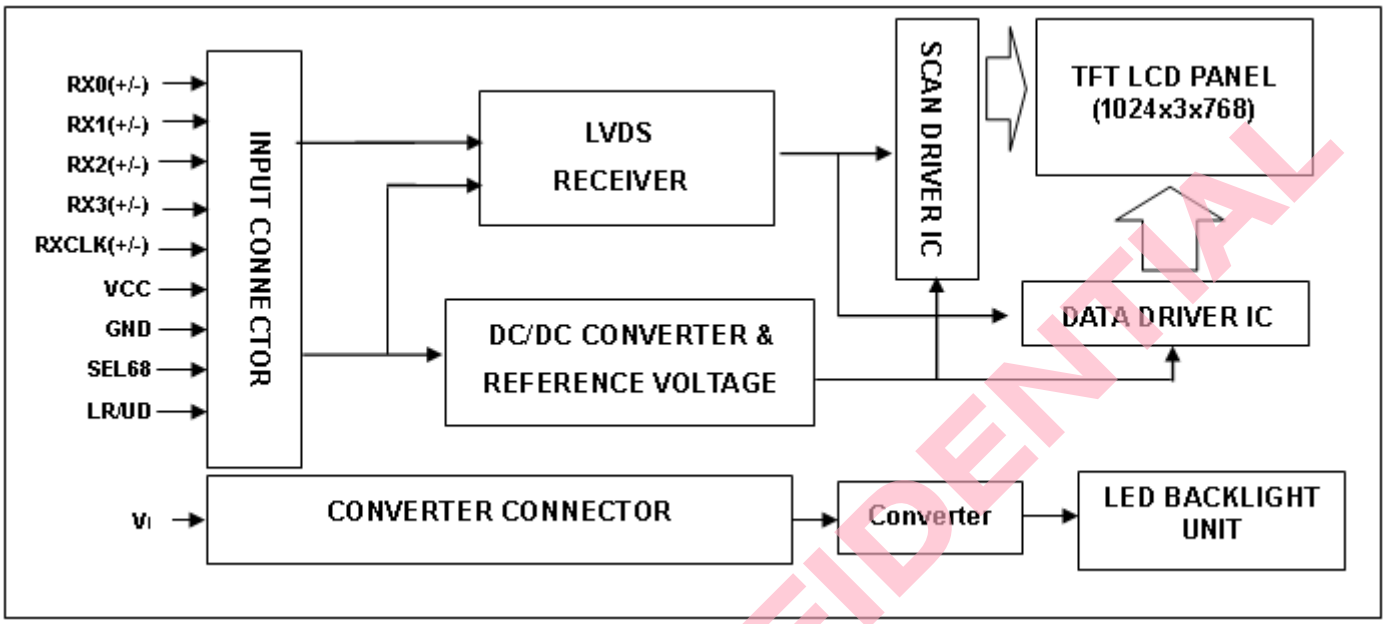
Item	Specification	Unit	Note
Active Area	245.76(H) x 184.32(V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1024 x R.G.B. x 768	pixel	-
Pixel Pitch	0.240(H) x 0.240(V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262k/16.7M	color	-
Transmissive Mode	Normally black / AAS	-	-
Surface Treatment	Hard coating (3H), Anti-Glare	-	-
Module Power Consumption	10.12W (white pattern)	W	Typ

1.5 MECHANICAL SPECIFICATIONS

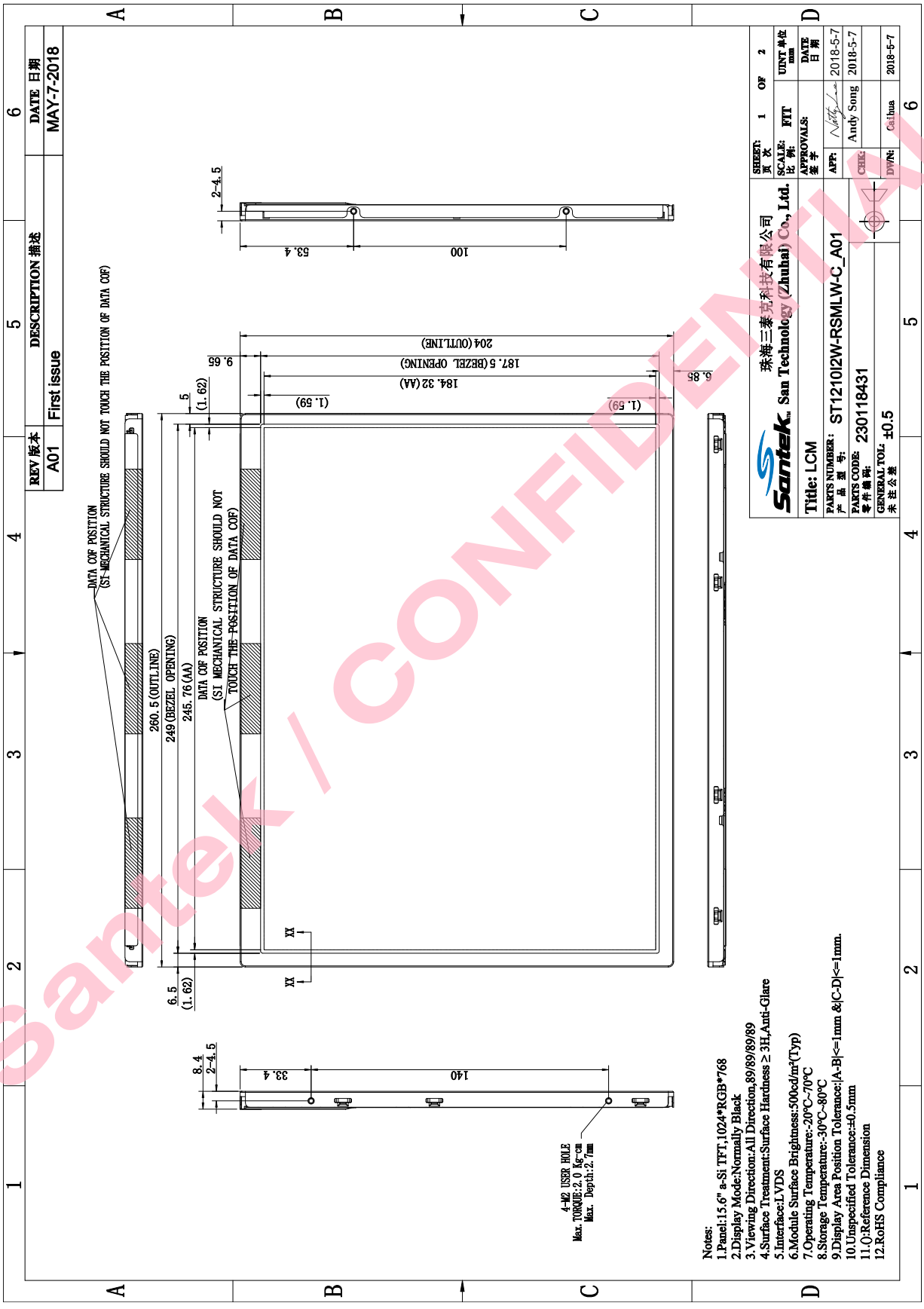
Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	260	260.5	261	mm	(1)
	Vertical(V)	203.5	204	204.5	mm	
	Depth(D)	7.9	8.4	8.9	mm	
Bezel Area	Horizontal	248.5	249	249.5	mm	-
	Vertical	187	187.5	188	mm	
Active Area	Horizontal	-	245.76	-	mm	
	Vertical	-	184.32	-	mm	
Weight		-	490	510	g	

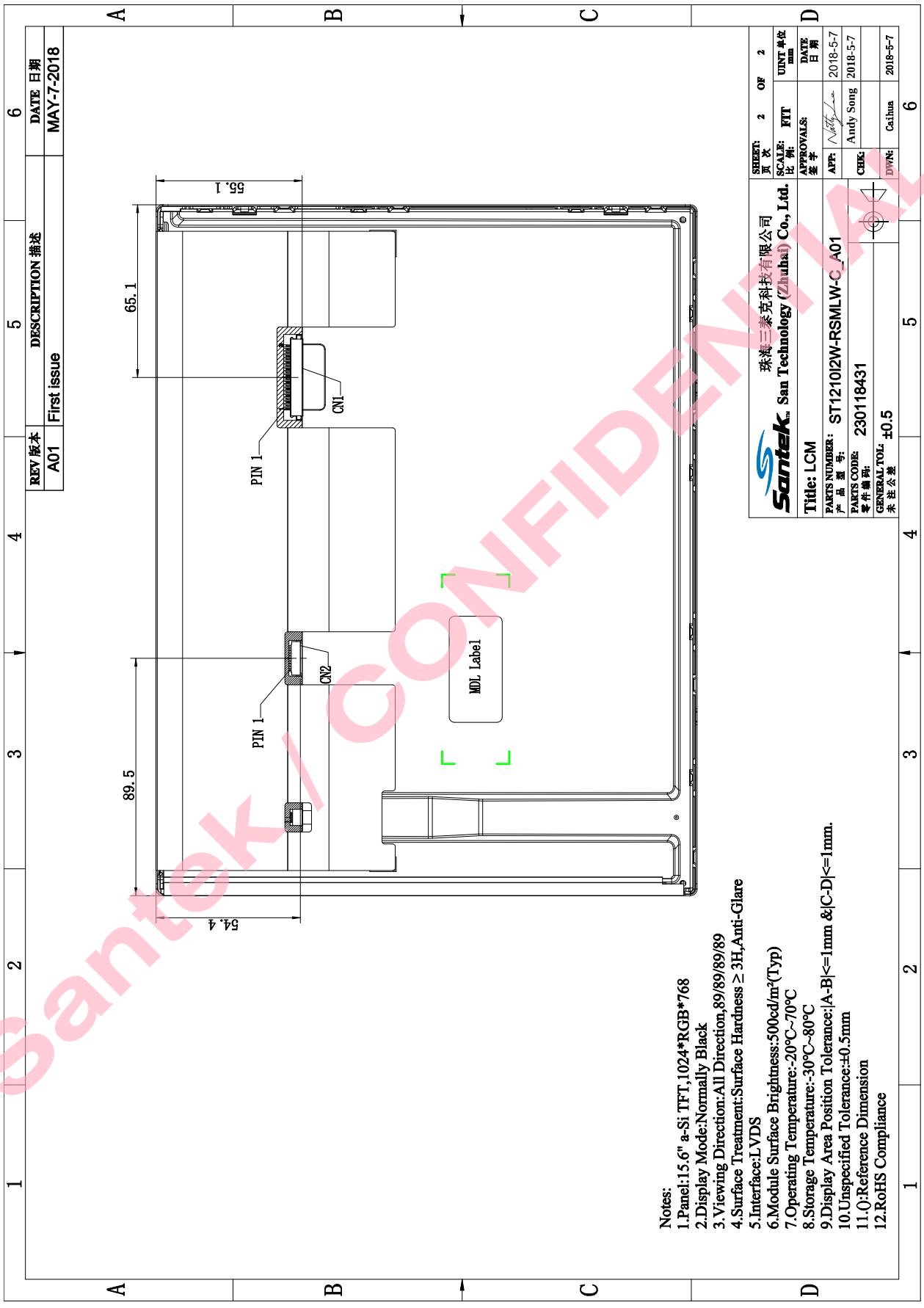
Note (1)Please refer to the attached drawings for more information of front and back outline dimensions.

2. Block Diagram



3. Mechanical Drawing





4. Pin Description

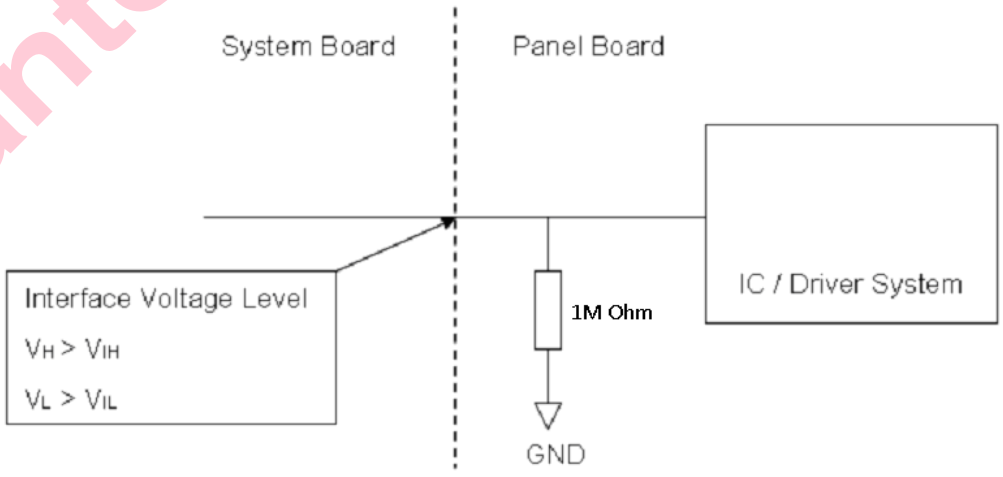
4.1 TFT LCD MODULE

Pin	Name	Description	Remark
1	RX3+	Differential Data Input, CH3 (Positive)	
2	RX3-	Differential Data Input, CH3 (Negative)	
3	NC	NC	
4	SEL68	LVDS 6/8 bit select function control, Low 6 bit Input Mode High 8bit Input Mode	Note (3) (4)
5	GND	Ground	
6	RXC+	Differential Clock Input (Positive)	
7	RXC-	Differential Clock Input (Negative)	
8	GND	Ground	
9	RX2+	Differential Data Input , CH2 (Positive)	
10	RX2-	Differential Data Input , CH2 (Negative)	
11	GND	Ground	
12	RX1+	Differential Data Input , CH1 (Positive)	
13	RX1-	Differential Data Input, CH1 (Negative)	
14	GND	Ground	
15	RX0+	Differential Data Input, CH0 (Positive)	
16	RX0-	Differential Data Input, CH0 (Negative)	
17	reLR	Horizontal Reverse Scan Control, Low Normal Mode. High Horizontal Reverse Scan	Note (3) (4)
18	reUD	Vertical Reverse Scan Control, Low Normal Mode, High Vertical Reverse Scan	Note (3) (4)
19	VCC	Power supply	
20	VCC	Power supply	

Note (1) Connector Part No.: P-TWO 187191-20101-3 or STARCONN 076B20-0048RA-G4 or equivalent. Note (2) User's connector Part No.: JAE FI-SE20ME or equivalent.

Note (3) "Low" stands for 0V. "High" stands for 3.3V.

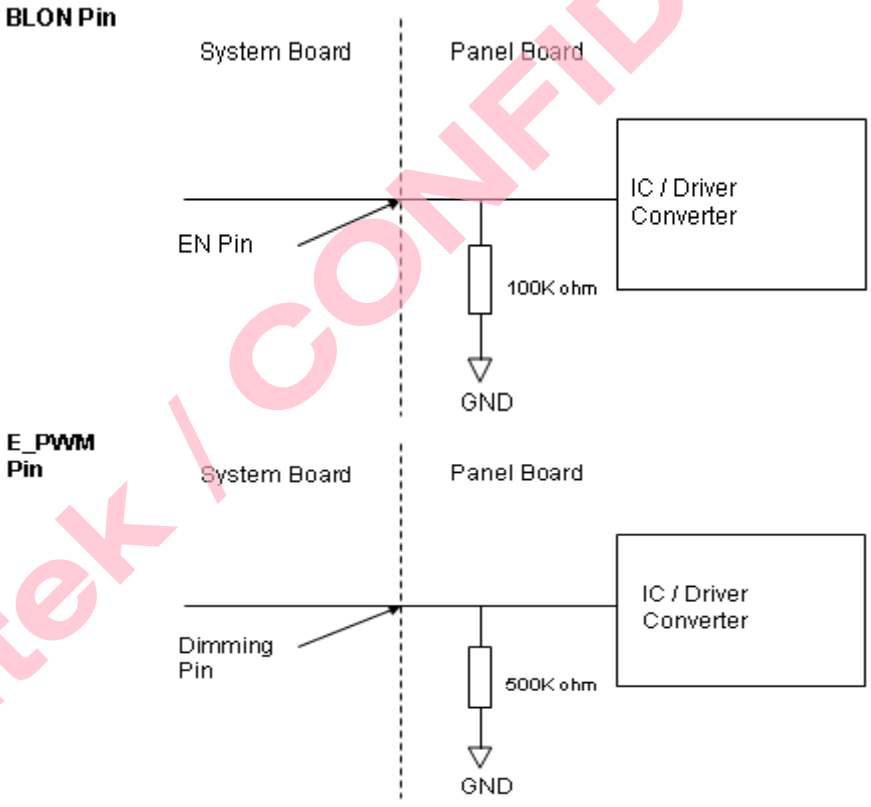
Note (4) SEL68, reLR, reUD



4.2 BACKLIGHT UNIT(CONVERTER CONNECTOR PIN)

Pin	Symbol	Description	Remark
1	Vi	Converter input voltage	12V
2	Vi	Converter input voltage	12V
3	Vi	Converter input voltage	12V
4	Vi	Converter input voltage	12V
5	VGND	Converter ground	Ground
6	VGND	Converter ground	Ground
7	VGND	Converter ground	Ground
8	VGND	Converter ground	Ground
9	EN	Enable pin	3.3V, Note (3)
10	ADJ	Backlight Adjust	PWM Dimming (190-210Hz, Hi: 3.3VDC, Lo: 0VDC) , Note (3)

Note (1) Connector Part No.: 91208-01001-H01 (ACES) or equivalent. Note (2) User's connector Part No.: 91209-01011 (ACES) or equivalent Note (3) EN(BLON), ADJ(E_PWM) as shown below :



4.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-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					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
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
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	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
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	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
	Blue(1)	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	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

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

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(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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	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) Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	:	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(253)	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(254)	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(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
		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. Electrical Characteristics

5.1 Absolute Ratings Of Environment

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Operating Ambient Temperature	T_{OP}	-30	+70	ºC	(1)(2)
Storage Temperature	T_{ST}	-40	+80	ºC	

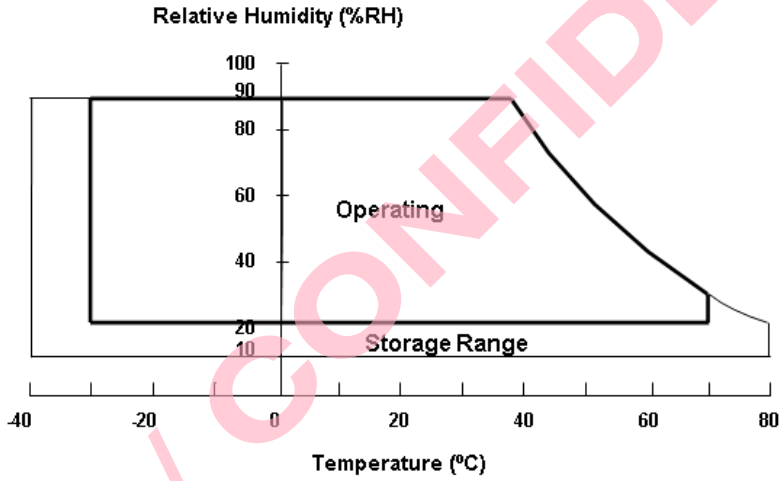
Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max.

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

(c) No condensation.

Note (2)Panel surface temperature should be 0℃ min. and 65℃ max under Vcc=3.3V, fr =60Hz, typical LED string current, 25℃ ambient temperature, and no humidity control . Any condition of ambient operating temperature ,the surface of active area should be keeping not higher than 65℃.



5.2 Electrical Absolute Ratings

5.2.1 Absolute Maximum Ratings

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCC	-0.3	3.6	V	(1)
Logic Input Voltage	V_{IN}	-0.3	3.6	V	

5.2.2 Backlight Unit

Item	Symbol	Value		Unit	Note
		Min.	Max.		
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.

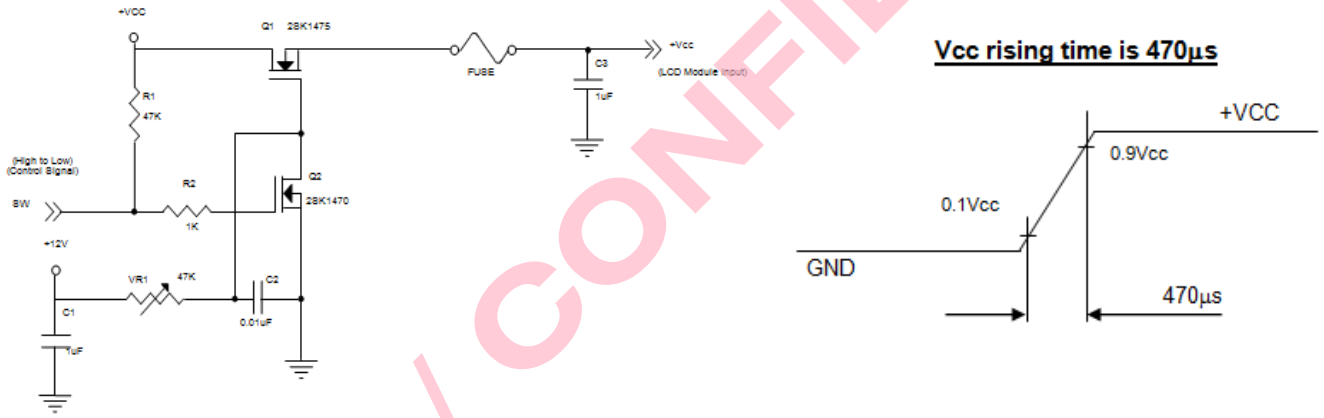
Note (2) Specified values are for lamp (Refer to 3.2 for further information).

5.3 TFT LCD Module

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	3.15	3.3	3.45	V	-
Ripple Voltage		V_{RP}	-	-	200	mVp-p	
Inrush Current		I_{INRUSH}	-	-	4	A	(2)
Power Supply Current	White	Icc	-	520	620	mA	(3)a
	Black		-	420	510	mA	(3)b
LVDS differential input voltage		V_{id}	100	-	600	mV	
LVDS common input voltage		V_{ic}	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 Vcc = 3.3V, Ta = 25 ± 2 ºC, f_v = 60 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

Active Area

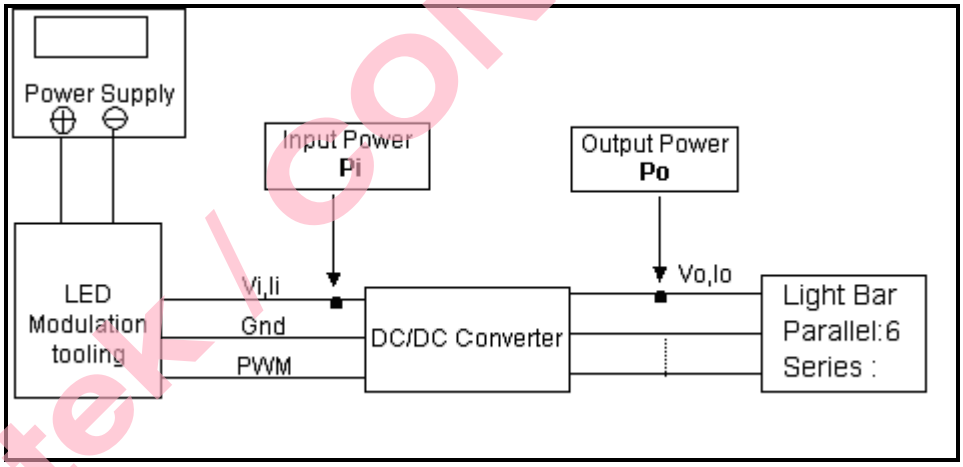
b. Black Pattern

Active Area

5.5 Backlight Unit

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Converter Input Voltage		Vi	10.8	12.0	13.2	VDC	(Duty 100%)
Converter Input Ripple Voltage		ViRP	-	-	500	mV	
Converter Input Current		Ii	-	0.7	0.85	ADC	@ Vi = 12V (Duty 100%)
Converter Inrush Current		IiRUSH	-	-	3.0	A	@ Vi rising time=20ms (Vi=12V)
Input Power Consumption		Pi	-	8.4	10.2	W	(1)
EN Control Level	Backlight on	ENLED (BLON)	2.5	3.3	5.0	V	
	Backlight off		0	---	0.3	V	
PWM Control Level	PWM High Level	Dimming (E_PWM)	2.5	3.3	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 Control Duty Ratio		-	5		100	%	(2), @ 190Hz< f_{PWM} <1kHz
			20	-	100	%	(2), @ 1kHz≦f_{PWM} <20kHz
LED Life Time		LLED	30,000	-	-	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 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.

6. Interface Timing

6.1 Input Signal Timing Specifications

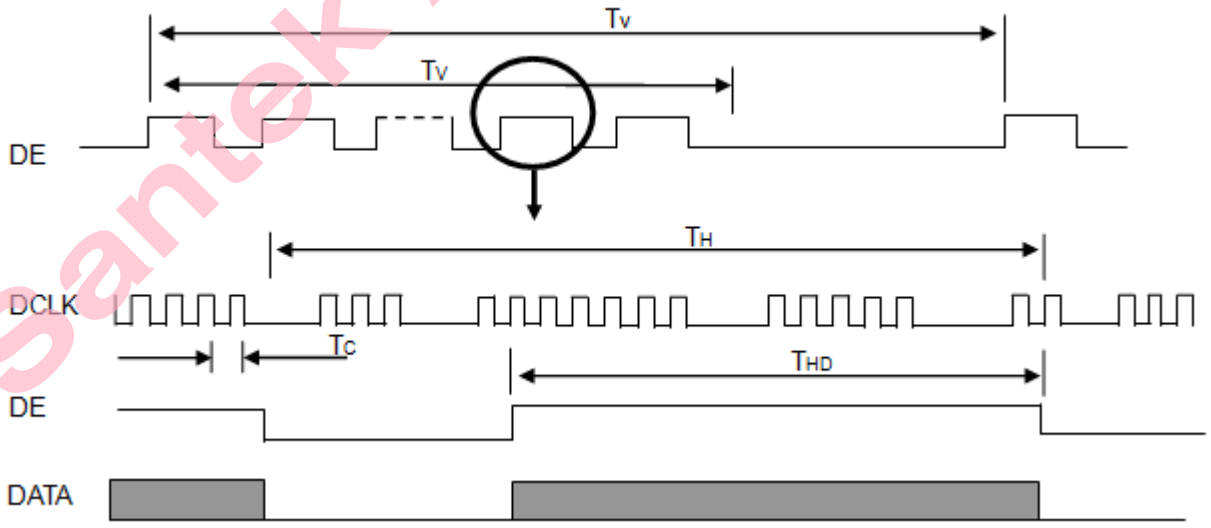
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	57.7	65	73.6	MHz	-
	Period	Tc	13.6	15.4	17.3	ns	
	Input cycle to cycle jitter	Trcl	---	---	200	ns	(a)
	Input Clock to data skew	TLVCCS	-0.02*Tc	---	0.02*Tc	ps	(b)
	Spread spectrum modulation range	Fclkin_mod	0.987*Fc	---	1.013*Fc	MHz	(c)
	Spread spectrum modulation frequency	FSSM	---	---	200	KHz	
	High Time	Tch	---	4/7	---	Tch	
	Low Time	Tcl	---	3/7	---	Tch	
Vertical Display Term	Frame Rate	Fr	---	60	---	Hz	Tv=Tvd+Tvb
	Total	Tv	776	806	838	Th	-
	Active Display	Tvd	768	768	768	Th	-
	Blank	Tvb	8	38	70	Th	-
Horizontal Display Term	Total	Th	1240	1344	1464	Tc	Th=Thd+Thb
	Active Display	Thd	1024	1024	1024	Tc	-
	Blank	Thb	216	320	440	Tc	-

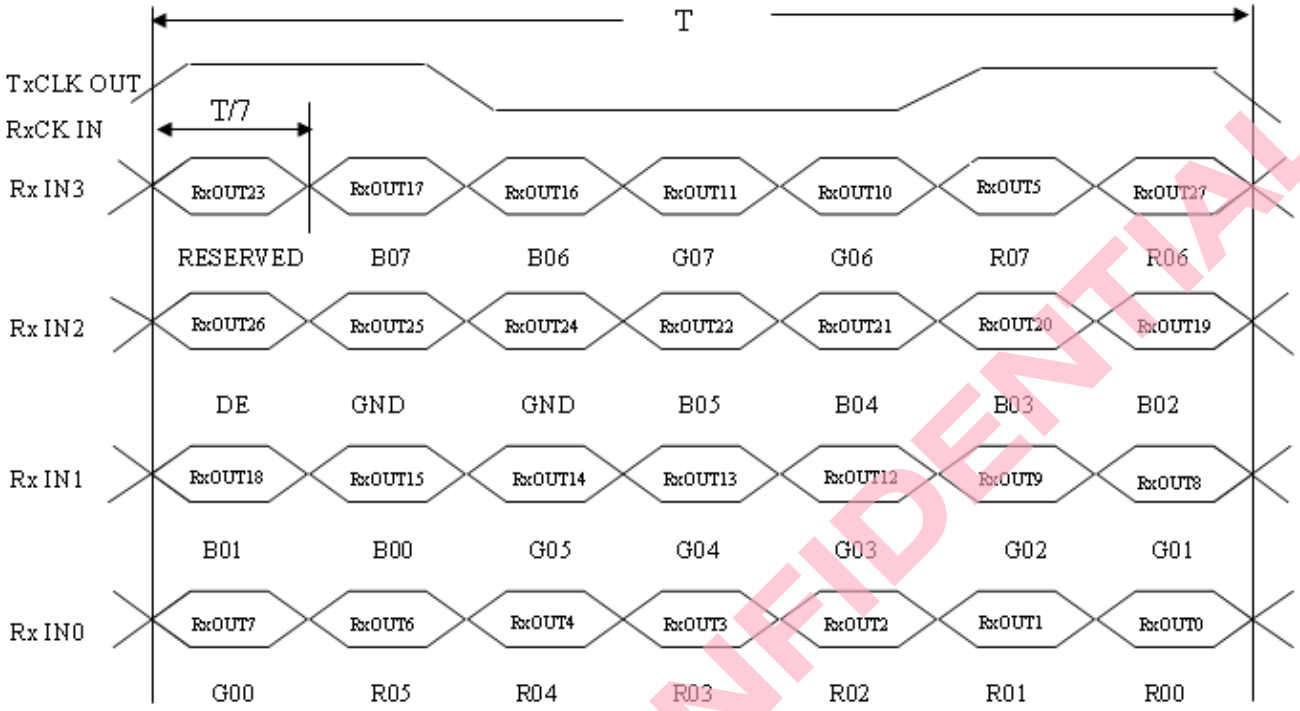
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

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

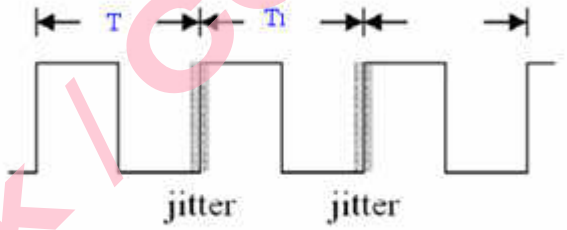
INPUT SIGNAL TIMING DIAGRAM



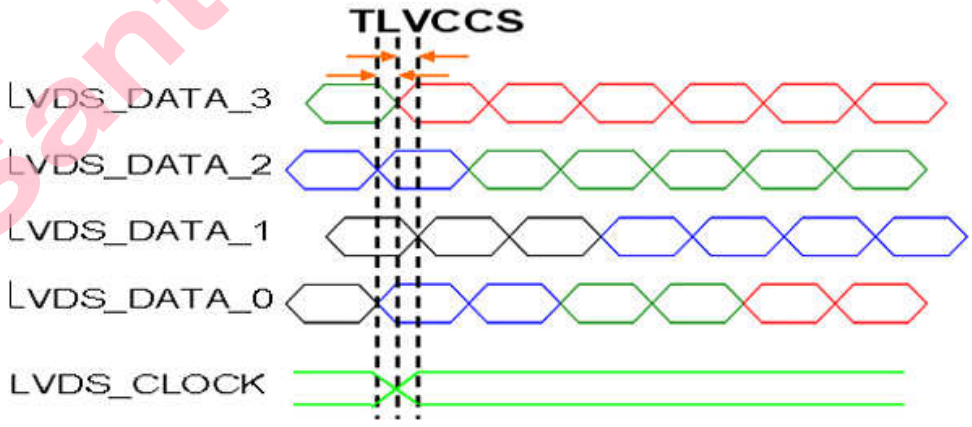
TIMING DIAGRAM of LVDS



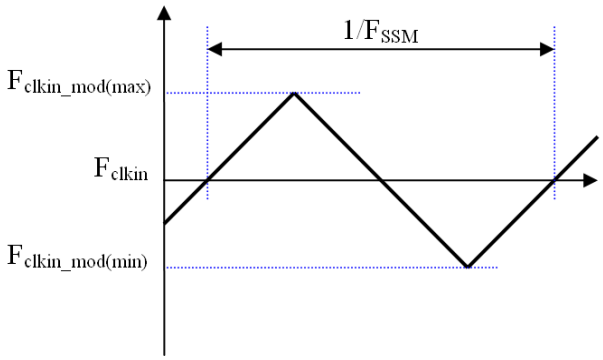
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T_1 – TI



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

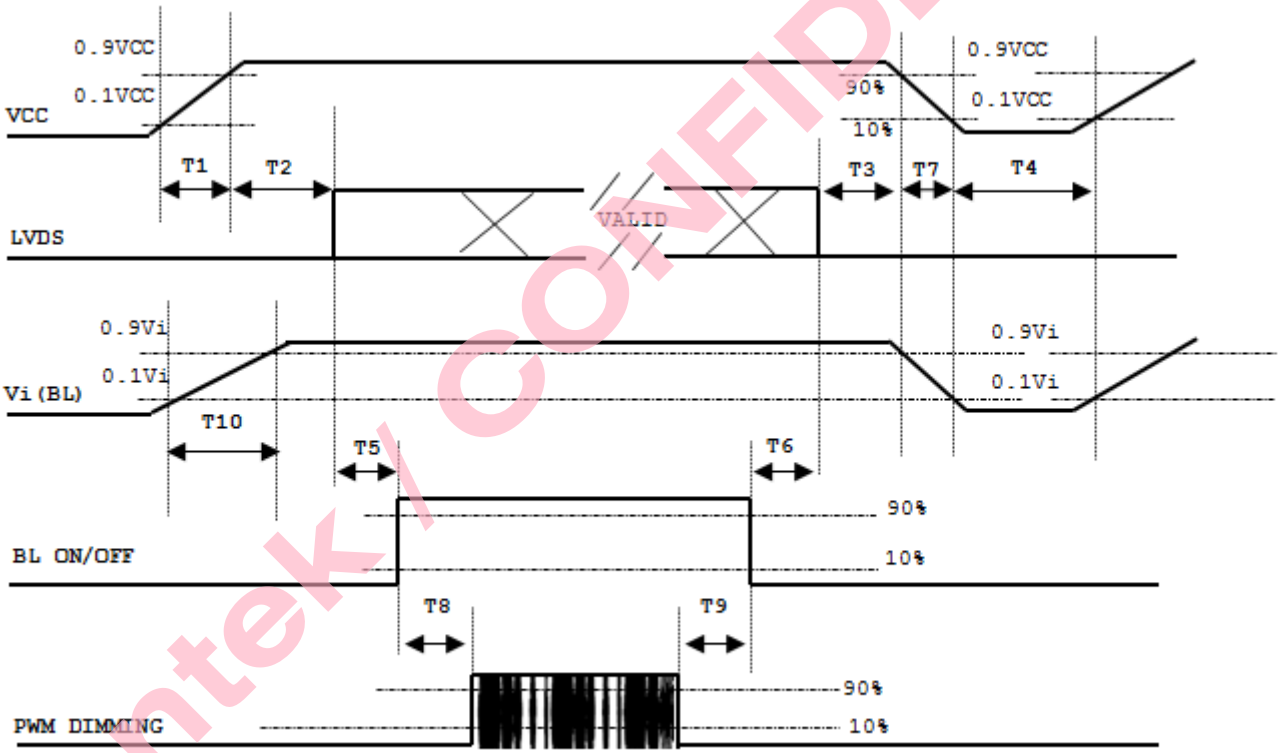


Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



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.



Parameter	Value			Units
	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
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.

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

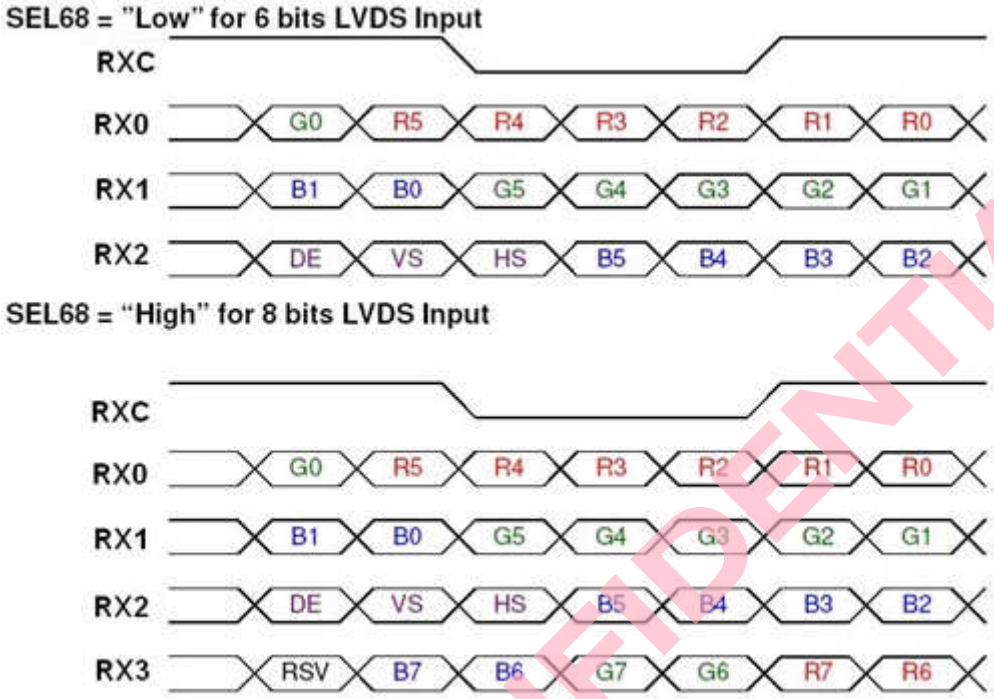
Note(3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.

Note(4) T4 should be measured after the module has been fully discharged between power off and on period. Note(5) Interface signal shall not be kept at high impedance when the power is on.

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

Note(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".

6.3 The Input Data Format



Note (1) R/G/B data 7: MSB, R/G/B data 0: LSB

Note (2) Please follow PSWG

Signal Name	Description	Remark
R7 R6 R5 R4 R3 R2 R1 R0	Red Data 7 (MSB) Red Data 6 Red Data 5 Red Data 4 Red Data 3 Red Data 2 Red Data 1 Red Data 0 (LSB)	Red-pixel Data Each red pixel's brightness data consists of these 8 bits pixel data.
G7 G6 G5 G4 G3 G2 G1 G0	Green Data 7 (MSB) GreenData 6 GreenData 5 GreenData 4 GreenData 3 GreenData 2 GreenData 1 GreenData 0 (LSB)	Green-pixel Data Each green pixel's brightness data consists of these 8 bits pixel data.
B7 B6 B5 B4 B3 B2 B1 B0	Blue Data 7 (MSB) Blue Data 6 Blue Data 5 Blue Data 4 Blue Data 3 Blue Data 2 Blue Data 1 Blue Data 0 (LSB)	Blue-pixel Data Each blue pixel's brightness data consists of these 8 bits pixel data.
RXCLKIN+ RXCLKIN-	LVDS Clock Input	
DE	Display Enable	
VS	Vertical Sync	
HS	Horizontal Sync	

Note (3) Output signals from any system shall be low or Hi-Z state when VCC is off.

6.4 SCANNING DIRECTION

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

Fig.1 Normal Scan

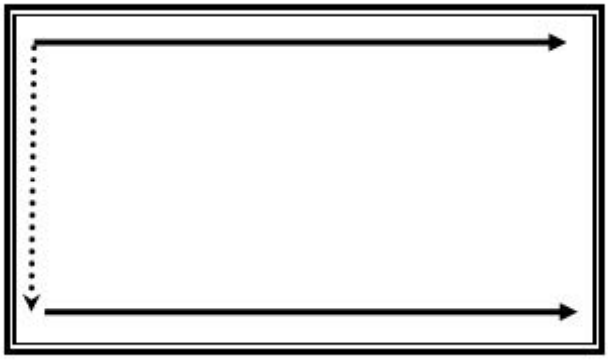


Fig.2 Reverse Scan

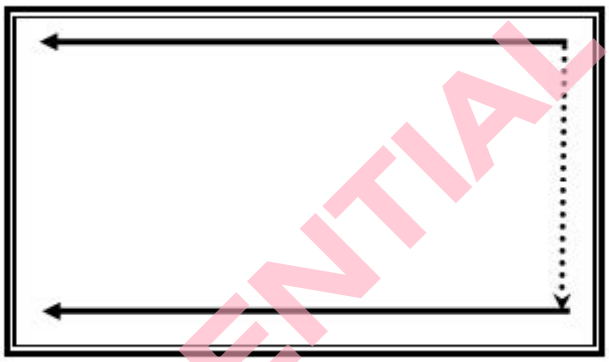


Fig.3 Reverse Scan

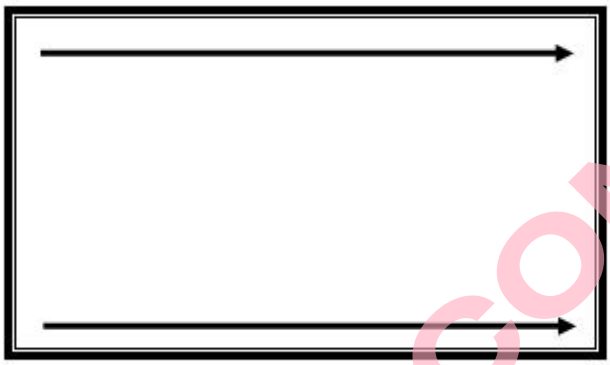


Fig.4 Reverse Scan

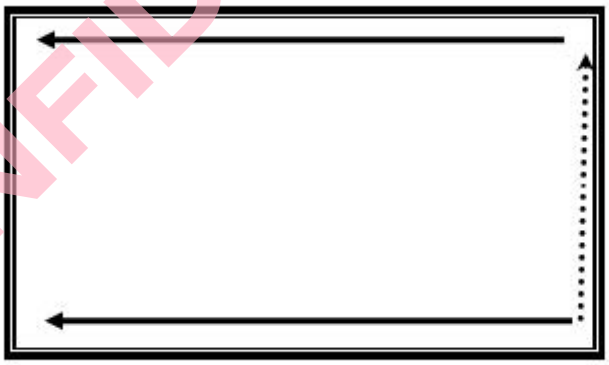


Fig. 1 Normal scan (pin 17, reLR = Low, pin 18, reUD = Low)

Fig. 2 Reverse scan (pin 17, reLR = High, pin 18, reUD = Low)

Fig. 3 Reverse scan (pin 17, reLR = Low, pin 18, reUD = High)

Fig. 4 Reverse scan (pin 17, reLR = High, pin 18, reUD = High)

7. Optical Characteristics

7.1 Test Conditions

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	oC
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	According to typical value and tolerance in "ELECTRICAL CHARACTERISTICS"		
Input Signal			
PWM Duty Ratio	D	100	%

7.2 Optical Specifications

The relative measurement methods of optical characteristics are shown in 7.2 and all items are measured at the center point of screen except white variation. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (5).

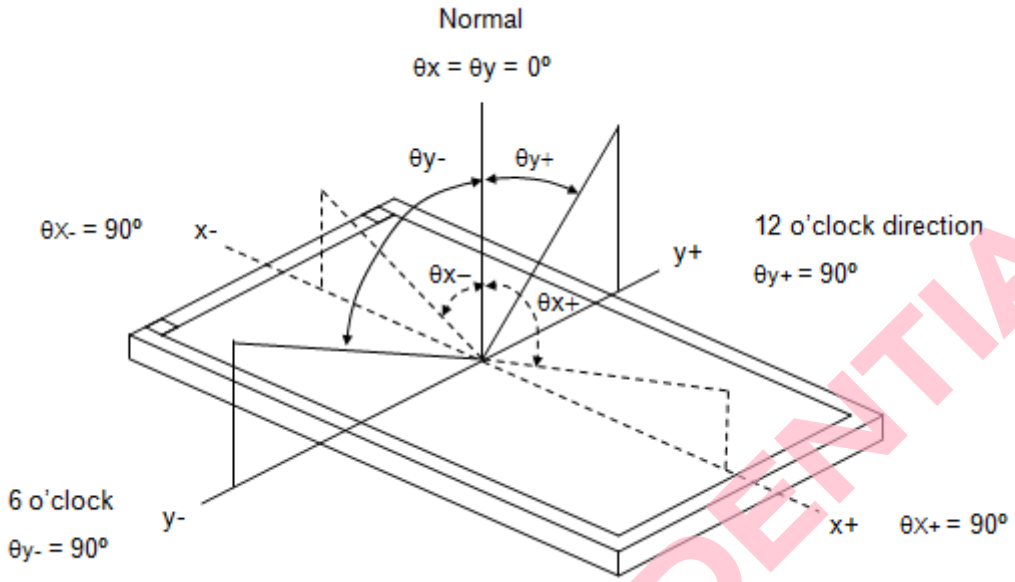
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity	Red	Rx	θX=0°, Y =0° Grayscale Maximum	0.602	0.652	0.702	-	(1), (5)
		Ry		0.288	0.338	0.388	-	
	Green	Gx		0.274	0.324	0.374	-	
		Gy		0.557	0.607	0.657	-	
	Blue	Bx		0.103	0.153	0.203	-	
		By		0	0.048	0.098	-	
	White	Wx		0.263	0.313	0.363	-	
		Wy		0.279	0.329	0.379	-	
Center Luminance of White		LC		400	500	-	cd/m2	(4), (5)
Contrast Ratio		CR		700	1000	-		(2), (5)
Response Time		TR	θx=0°, Y =0°	-	13	18	ms	(3)
		TF		-	12	17	ms	
White Variation		δW	θx=0°, Y =0°	75	80	-	%	(5), (6).
Viewing Angle	Horizontal	θx+	CR□10	85	89	-	Deg.	(1), (5)
		θx-		85	89	-		
	Vertical	θY+		85	89	-		
		θY		85	89			

Definition： -

Grayscale Maximum : Grayscale 255 (10 bits: grayscale 1023 ; 8 bits : grayscale 255 ; 6 bits: grayscale 63) White : Luminance of Grayscale Maximum (All R,G,B)

Black : Luminance of grayscale 0 (All R,G,B)

Note (1) Definition of Viewing Angle (□x, □y):

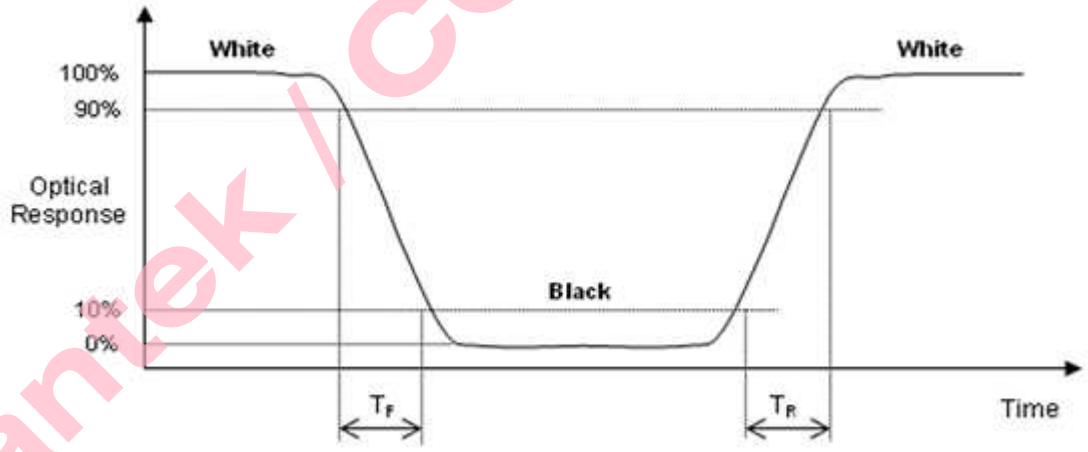


Note (2)Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = White / Black

Note (3)Definition of Response Time (T_R, T_F):

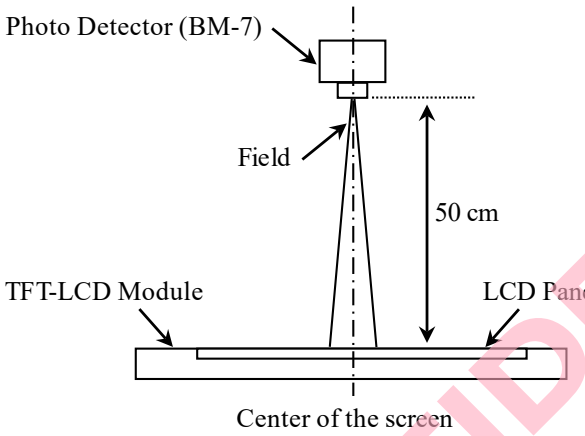


Note (4) Definition of Luminance of White (L_C):

Measure the luminance of White 255 at center point

Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room. The measurement placement of module should be in accordance with the module drawing.

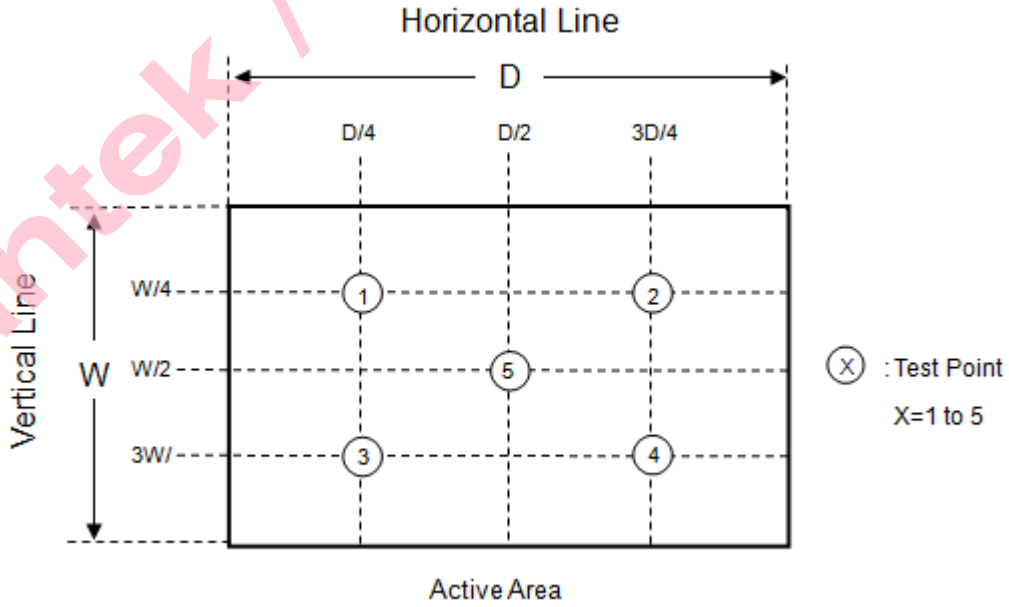


Note (6) Definition of White Variation (δW):

Measure the luminance of White at 5 points.

Luminance of White : L(X) , where X is from 1 to 5.

$$\delta W = \frac{\text{Minimum [L(1) to L(5)]}}{\text{Maximum [L(1) to L(5)]}} \times 100\%$$



8. Reliability Tests

No.	Item	Condition	Criterion
1	High Temperature Storage	80℃,120 Hours	No defects in display and operational functions
2	Low Temperature Storage	-30℃,120 Hours	
3	High Temperature Operating	70℃,120 Hours	
4	Low Temperature Operating	-20℃,120 Hours	
5	High Temperature and Humidity Test(Storage)	60℃,90%RH,120 Hours	
6	Thermal Shock	-30℃(30mins)→80℃(30mins),10Cycle	
7	Electro-Static Discharge (Operating)	C=150pF, R=330Ω, 5 Point/Panel Contact Discharge: ±4KV, 5 times Air Discharge: ±8KV, 5 times	
8	Package Vibration Test	Frequency Range:10~55Hz Stroke: 5mm Sweep:1 hours for each direction of X.Y.Z (3 hours for total)	
9	Package Drop Test	Height: According to GB/T 2423.8-1995 1 Corner, 3 Edges, 6 Surfaces	

Remark:

1. The Test samples should be applied to only one test item.
2. Sample for each test item is 2 pcs.
3. The samples must be free from defect before test, must be restored at room condition at least for 2 hours storage at room temperature after reliability test before any inspection.
4. After a long period of high temperature, the surrounding edge of the LCM all-black image maybe appear MURA phenomenon, which is a normal phenomenon.
5. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

9. Package Drawing

TBD

10. Incoming Inspection Specification

According to Santek Inspection Standard.

11. Cautions

a. Recommended Storage condition: Temperature: 25ºC+/-5ºC, Humidity: ≤75%RH. Clear and free with dust and flowing particles space.

b. Don't disassemble and reassemble the module by yourself.

c. Acid, alkali, alcohol or touched directly by hand will damage the display.

d. Static electricity will damage the module. Please configure grounding device. And enough anti-statics protection when touching products.

e. The strong vibration, shock, twist or bend will cause material damage, even module broken.

f. It is easy to cause image sticking while displaying the same pattern for very long time.

g. The response time, brightness and performance will vary from different temperature.

h. LCD Devices are made of fragile material such as Glass and may be broken or cracked if dropped it, so please handle them with care. Please be careful not to cut your hand if you break the glass.

i. Do not stack the LCDs to avoid the LCDs damage and contamination.

j. Before using the LCDs, please check the specification.

k. LCDs contain a small amount of Liquid Crystal. Please follow local ordinances or regulations for disposal.

l. LCD shall be stored in same packing material during import, and under the condition of room temperature (20-30 degree C).

m. Please do not leave LCD modules under the direct sunlight or strong infra-red radiation for a long period time to prevent liquid crystal deteriorating.

n. Please turn off the power supply before plugging or unplugging LCD module.

o. Please do not rub, push, or hit LCD surface with hard tool etc. Film on surface is easily scratched, when droplets of water or dirt are on the surface, please gently remove them with soft fabric.

p. Handling of main and LED FPC (Flexible Printed Circuit), please be careful, do not strongly pull or scratch FPC, to avoid failure of the components and bonding part.

12. Limited Warranty

Unless otherwise agreed between Santek and customer, Santek will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with Santek LCD acceptance standards(copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects over specs must be returned to Santek within 30 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of Santek limited to repair and/or replacement on the terms set forth replacement on the terms setforth above. Santek shall not be responsible for any subsequent or consequential events.

12.1 Returning LCM Under Warranty –Terms and Conditions

a. No warranty can be granted if the precautions stated above have been disregarded.
The typical examples of violations are:
- Broken LCD glass.
- Circuit modified in any way, including addition of components.

b. Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB's eyelet, conductors and terminals.