San Technology, Inc.

SPECIFICATION
FOR
LCD Module

Customer P/N:

Santek P/N: ST0103A2W-WSNLW-F

DOC. Revision: RS04

Customer Approval:

	SIGNATURE	DATE
PREPARED BY	Zhiyi Liao	2018.09.06
CHECKED BY	Andy Song	2018-9-6
APPROVED BY	Natty Lee	2018-Sep-6

Document Revision History

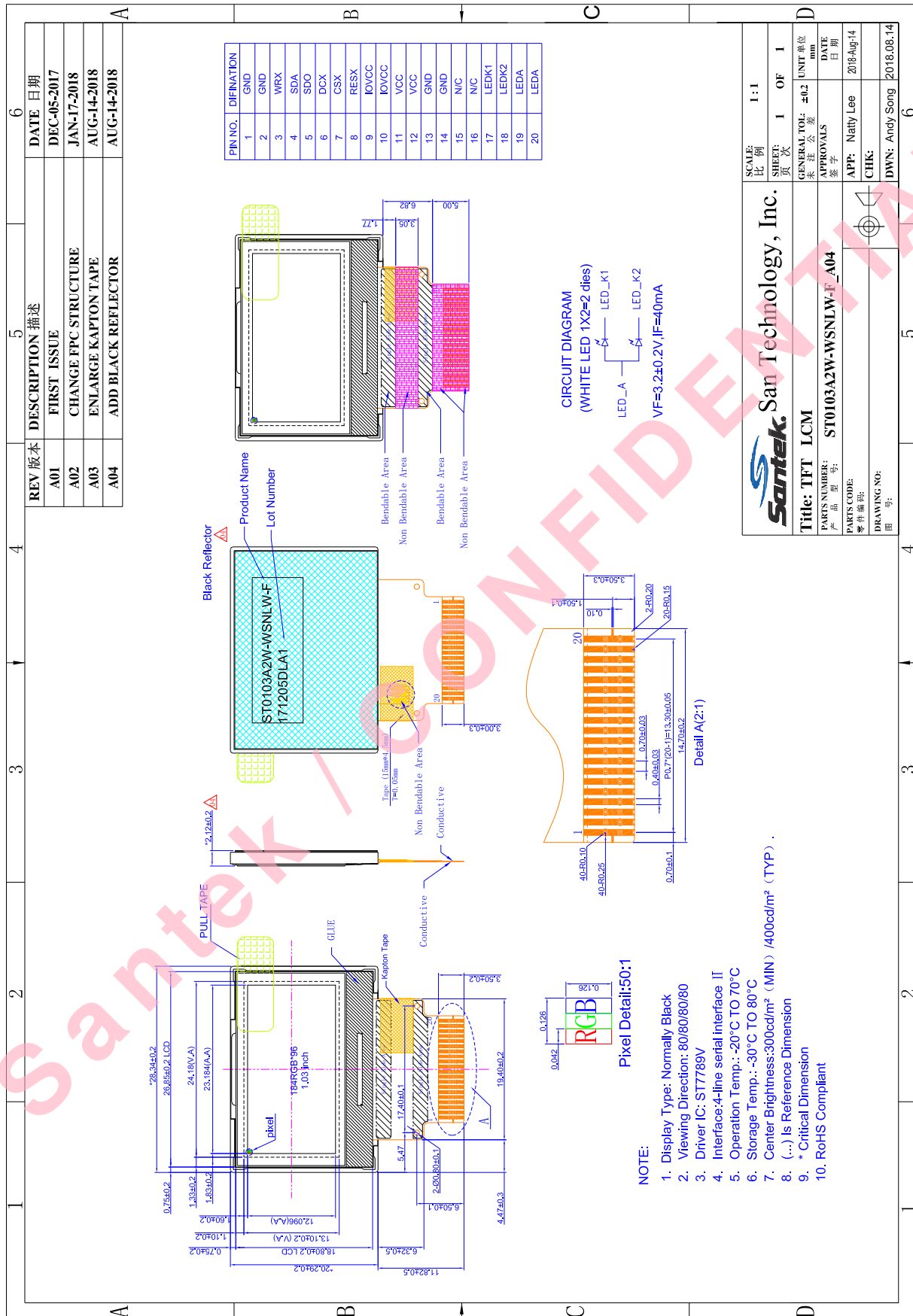| Revision	Date	Description	Changed by
RS01	2017-12-07	Initial release	Zhiyi Liao
RS02	2018-01-18	Update mechanical drawing	Vivian Huang
RS03	2018-04-10	Update product weight & packing	Vivian Huang
RS04	2018-09-06	Update mechanical drawing & product weight & packing	Zhiyi Liao

Table of Contents

1. General Specification

ITEM	STANDARD VALUES	UNITS
LCD Type	1.03 inch TFT	--
Dot Arrangement	184 RGB×96	dots
Color Filter Array	RGB - Stripe	--
Display Mode	Transmissive / Normally Black	--
Viewing Direction(Gray Inversion)	ALL Direction	--
Driver IC	ST7789V	--
Module Size	28.34W×20.29(H)×2.12(T)	mm
Active Area	23.184(H)×12.096(V)	mm
Dot Pitch	0.126(W)×0.126(H)	mm
Interface	4-Line Serial Interface Ⅱ	--
Operating Temperature	-20 ~ +70	℃
Storage Temperature	-30 ~ +80	℃
Weight	1.80	g

2. Mechanical Drawing

PIN NO.	DIFINATION
1	GND
2	GND
3	WRX
4	SDA
5	SDO
6	DCX
7	CSX
8	RESX
9	IOVCC
10	IOVCC
11	VCC
12	VCC
13	GND
14	GND
15	N/C
16	N/C
17	LEDK1
18	LEDK2
19	LEDA
20	LEDA

REV 版本	DESCRIPTION 描述	DATE 日期
A01	FIRST ISSUE	DEC-05-2017
A02	CHANGE FPC STRUCTURE	JAN-17-2018
A03	ENLARGE KAPTON TAPE	AUG-14-2018
A04	ADD BLACK REFLECTOR	AUG-14-2018

CIRCUIT DIAGRAM
(WHITE LED 1X2=2 dies)
LED_K1
LED_K2
LED_A
$VF=3.2\pm0.2V, IF=40mA$

Product Name
Lot Number
Black Reflector
ST0103A2W-WSNLW-F
171205DLA1

Bendable Area
Non Bendable Area
Bendable Area
Non Bendable Area
Non Bendable Area
Conductive
PULL TAPE
GLUE
Kapton Tape

Detail A(2:1)
Pixel Detail:50:1
RGB
pixel
184RGB*96
1.03 inch

NOTE:
1. Display Type: Normally Black
2. Viewing Direction: 80/80/80/80
3. Driver IC: ST7789V
4. Interface:4-line serial Interface II
5. Operation Temp.:-20°C TO 70°C
6. Storage Temp.: -30°C TO 80°C
7. Center Brightness:300cd/m² （MIN）/400cd/m²（TYP）.
8. (...) Is Reference Dimension
9. * Critical Dimension
10. RoHS Compliant

San Technology, Inc.
Title: TFT LCM
ST0103A2W-WSNLW-F_A04
PARTS NUMBER: 产品型号:
PARTS CODE: 零件编码:
DRAWING NO: 图号:

SCALE: 比例	1:1
SHEET: 页次	1 OF 1
GENERAL TOL: 未注公差	±0.2
UNIT 单位	mm

APPROVALS 鉴字
APP: Natty Lee
CHK:
DWN: Andy Song
DATE 日期 2018-Aug-14 2018.08.14

3. Pin Description

Pin	Symbol	Description
1	GND	System Ground
2	GND	
3	WRX	Data is regarded as a command when WRX is low Data is regarded as a parameter or data when WRX is high
4	SDA	Serial input data
5	SDO	Serial output data
6	DCX	Clock signal
7	CSX	Chip selection signal
8	RESX	Reset signal
9	IOVCC	VDDI: Power Supply for I/O System
10	IOVCC	
11	VCC	VDD: Power Supply for Analog, Digital System and Booster Circuit
12	VCC	
13	GND	System Ground
14	GND	
15	NC	No connect
16	NC	No connect
17	LEDK1	Positive Power for BL LED
18	LEDK2	Positive Power for BL LED
19	LEDA	Negative Power for BL
20	LEDA	

4. Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage	VDD	- 0.3 ~ +4.6	V
Supply Voltage (Logic)	VDDI	- 0.3 ~ +4.6	V
Driver Supply Voltage	VGH-VGL	-0.3 ~ +30.0	V
Logic Input Voltage Range	VIN	0.3 ~ VDDI + 0.5	V
Logic Output Voltage Range	VO	0.3 ~ VDDI + 0.5	V
Operating Temperature Range	TOPR	-20~ +70	℃
Storage Temperature Range	TSTG	-30~ +80	℃

5. DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
System Supply Voltage	VDD	2.5	2.8	3.3	V	-
I/O Supply Voltage	VDDI	1.65	1.8	3.3	V	-
Input High Voltage	VIH	0.7IOVCC	-	IOVCC	V	-
Input Low Voltage	VIL	GND	-	0.3IOVCC	V	-
Output High Voltage	VOH	0.8IOVCC	-	IOVCC	V	IOH=-1.0mA
Output Low Voltage	VOL	GND	-	0.2IOVCC	V	IOH=1.0mA
I/O Leak Current	ILI	-	-	1	uA	-

6. Timing Characteristics

6.1 Power ON/OFF Sequence

VIO28 and VIO18 can be applied in any order.

VIO28and VIO18 can be power down in any order.

During power off, if LCD is in the Sleep Out mode, VIO28and VIO18 must be powered down minimum

120msec after RESET has been released.

During power off, if LCD is in the Sleep In mode, VIO28and VIO18 can be powered down minimum

0msec after RESET has been released.

CS can be applied at any timing or can be permanently grounded. RESET has priority over CS.

Note 1: There will be no damage to the display module if the power sequences are not met.
*Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.*
Note 3: There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.
Note 4: If RESET line is not held stable by host during Power On Sequence as defined in the sequence

below, then it will be necessary to apply a Hardware Reset (RESET) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

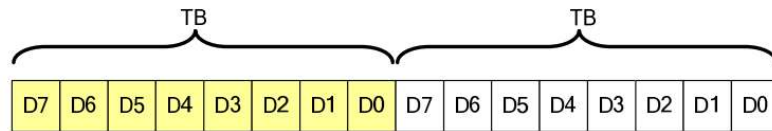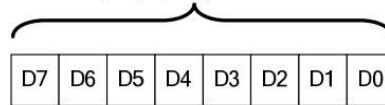The power on/off sequence is illustrated below
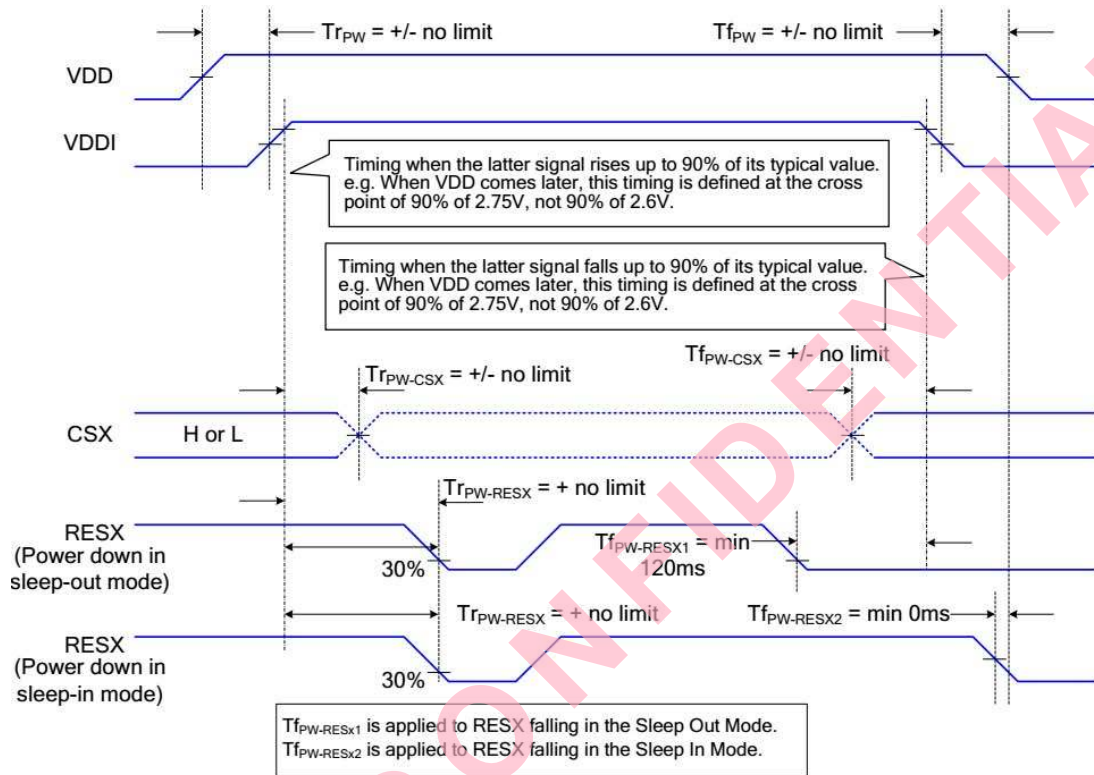
6.2 Uncontrolled Power Off

6.2.1 The uncontrolled power-off means a situation which removed a battery without the controlled power off sequence. It will neither damage the module or the host interface.

6.2.2 If uncontrolled power-off happened, the display will go blank and there will not any visible effect on the display (blank display) and remains blank until "Power On Sequence" powers it up.
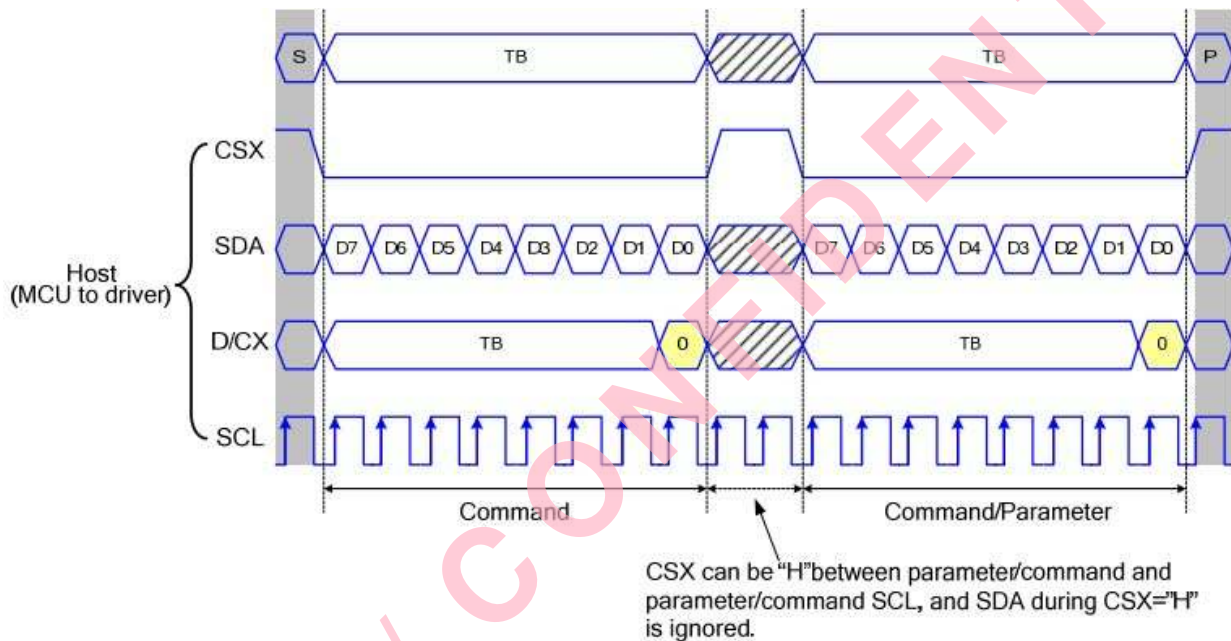
6.3 Send Data Sequence

6.3.1 The write mode of the interface means the micro controller writes commands and data to the LCD driver.

6.3.2 In 4-lines serial interface, data packet contains just transmission byte and control bit D/CX is transferred by the D/CX pin. If D/CX is "low", the transmission byte is interpreted as a command byte.

6.3.3 D/CX is "high", the transmission byte is stored in the display data RAM (memory write command), or command register as parameter.

6.3.4 Any instruction can be sent in any order to the driver. The MSB is transmitted first. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or SDA data have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission.

4-line serial data
stream format: Transmission byte (TB) may be command or data

D7	D6	D5	D4	D3	D2	D1	D0

				TB									TB			

D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0

Serial interface data stream format

CSX can be "H"between parameter/command and
parameter/command SCL, and SDA during CSX="H'
is ignored.

4-line serial interface write protocol (write to register with control bit in transmission)

6.3.5 When CSX is "high", SCL clock is ignored. During the high period of CSX the serial interface is initialized. At the falling edge of CSX, SCL can be high or low. SDA is sampled at the rising edge of SCL. D/CX   indicates whether the byte is command (D/CX='0') or parameter/RAM data (D/CX=' 1 '). D/CX is sampled when 8th rising edge of SCL. If CSX stays low after the last bit of command/data byte, the serial interface expects D7 of the next byte at the next rising edge of SCL..

6.3.6 Read function:

The read mode of the interface means that the micro controller reads register value from the driver. To achieve read function, the micro controller first has to send a command (read ID or register command) and then the following byte is transmitted in the opposite direction. After that CSX is required to go to high before a new command is send (see the below figure). The driver samples the SDA (input data) at rising edge of SCL, but shifts SDA (output data) at the falling edge of SCL. Thus the micro controller is supported to read at the rising edge of SCL.
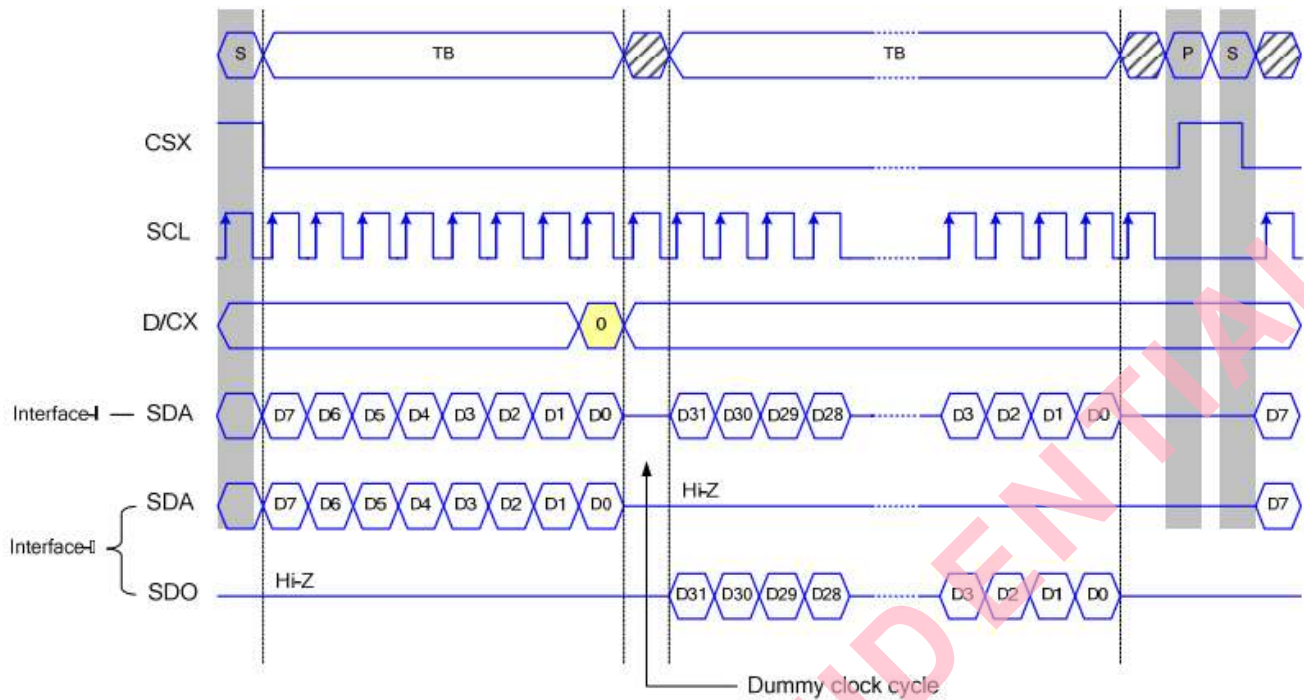
4-line serial interface read protocol

7. AC Characteristics

7.1 Serial Interface Characteristics (4-line serial)
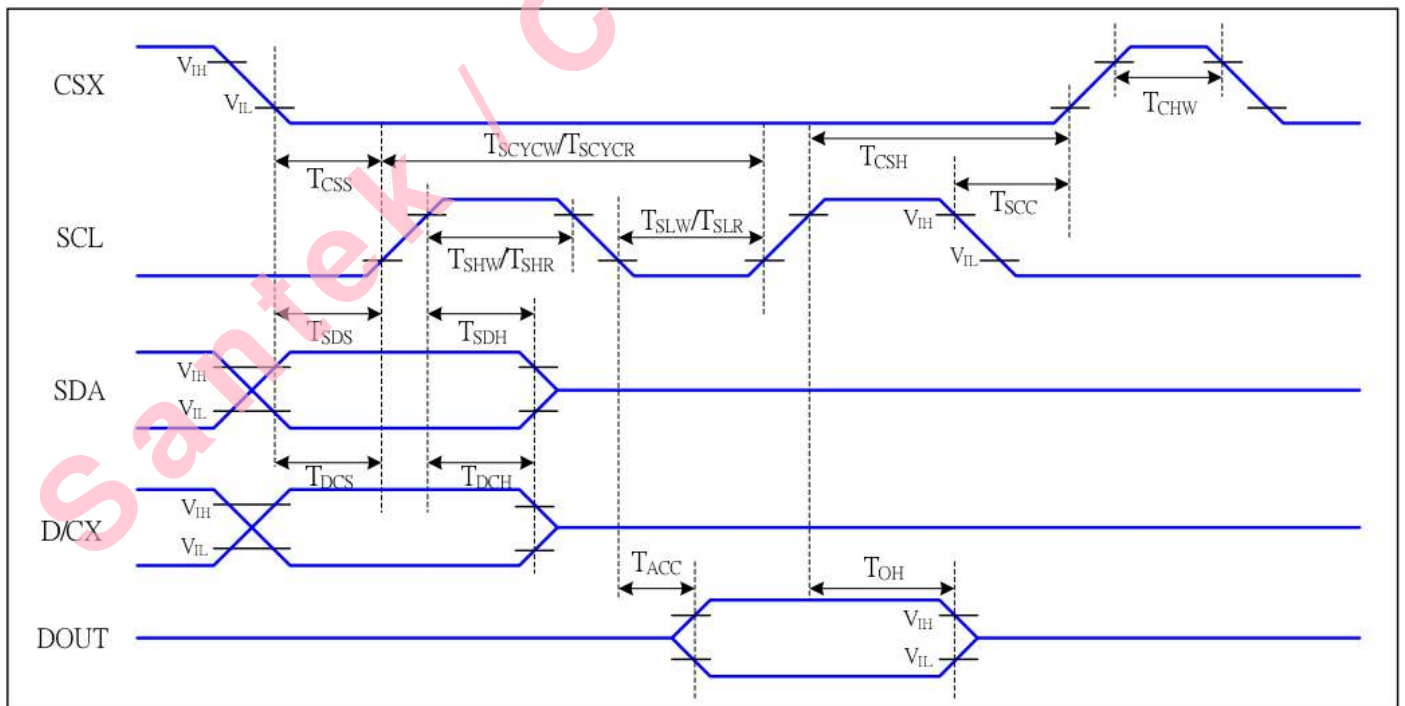

4-line serial Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

4-line serial Interface Characteristics

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for input signals.
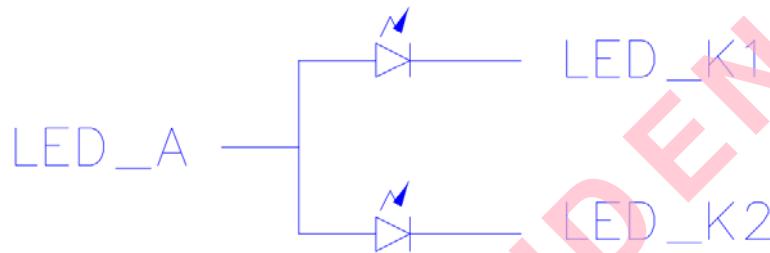
7.2 Reset Timing
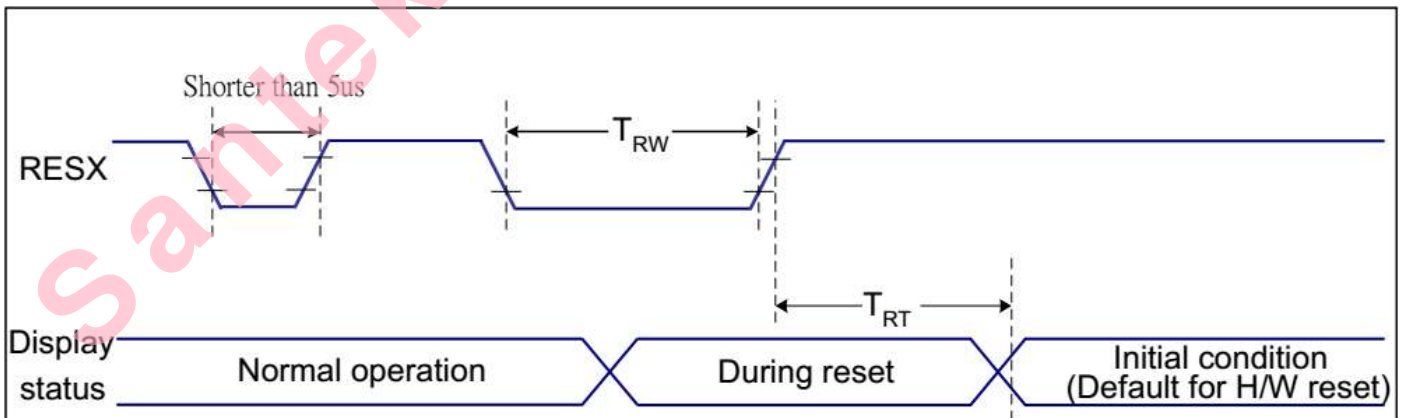
Reset Timing

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Reset Timing

8. Backlight Characteristics

BACKLIGHT LED CIRCUIT 2PCS LED

Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition
Supply Voltage	Vf	3.0	3.2	3.4	V	If=40mA
Supply Current	If	-	40	-	mA	-
Backlight Color	White					If=40mA

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9. Parameters and Specifications

9.1 Parameters and Specifications

Item		Symbol	Specifications			Unit	Note
			Min.	Typ.	Max.		
Transmittance		T%	-	2.8	-	%	
Contrast ratio*		Cr (Θ=0°)	300	350	-		
Response time (25℃)*		Tr + Tf	-	28	-	ms	
Viewing angle (Cr≥ 10)*		Θ21	-	80	-	deg	
		Θ22	-	80	-		
		Θ12	-	80	-		
		Θ11	-	80	-		
Chromaticity	**Red**	x	0.599	0.629	0.659	-	
		y	0.323	0.353	0.383		
	Green	x	0.328	0.358	0.388		
		y	0.573	0.603	0.633		
	Blue	x	0.125	0.155	0.185		
		y	0.065	0.095	0.125		
	White	x	0.280	0.310	0.340		
		y	0.305	0.335	0.365		
Color gamut of LCM (NTSC%)		S		58		%	
Luminous Intensity for LCM			300	400	-	CD/m2	
Uniformity for LCM			70			%	

9.2 Definitions and Measuring Methods

[1] Response Time(Tr、Tf)

The rise time 'Tr' is defined as the time for luminance to change from 90% to 10% as a result of a change of the electrical condition. The fall time 'Tf' is defined as the time for luminance to change from 10% to 90% as a result of a change of the electrical condition.
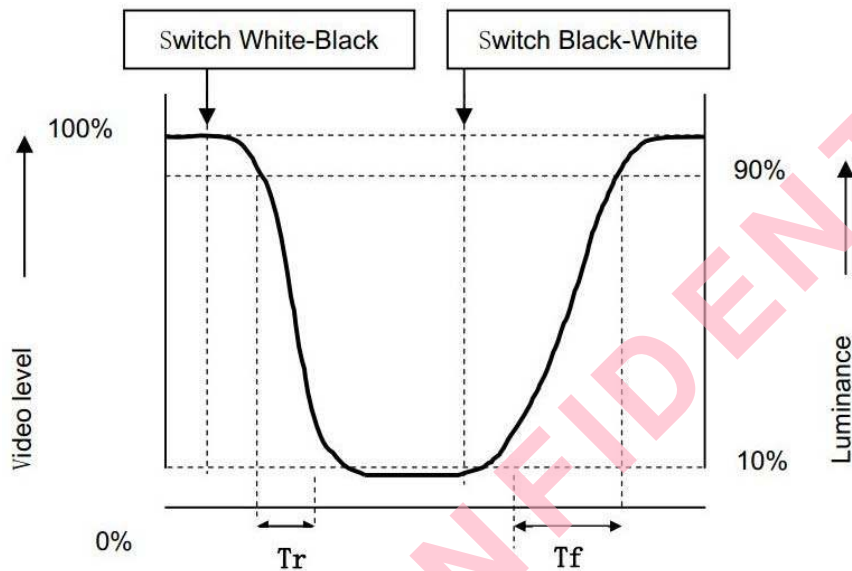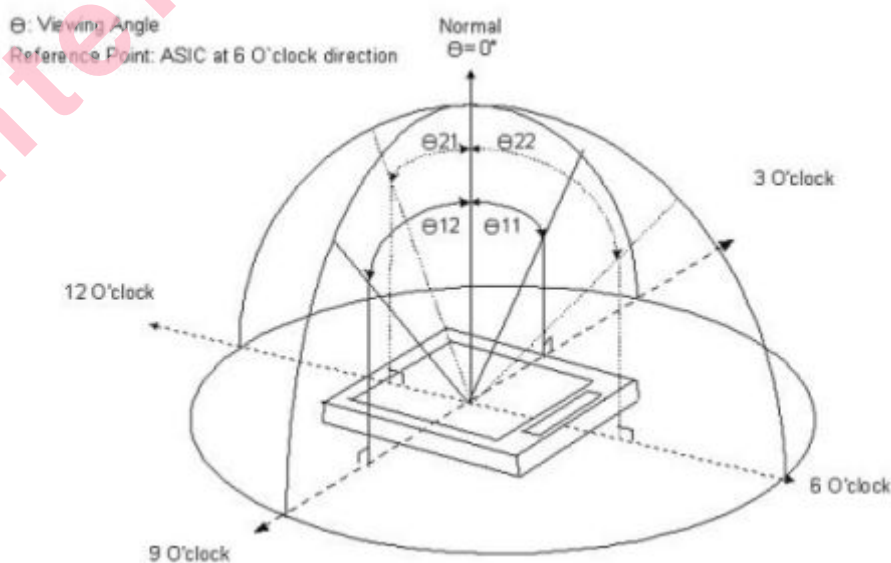

[2] Contrast Ratio (Cr)

The contrast ratio (Cr), measured on a module, is the ratio between the luminance (L_w) in a full white area (R=G=B=1) and the luminance (L_d) in a dark area (R=G=B=0):

$$Cr = \frac{L\_w}{L\_d}$$

[3] Viewing Angle Diagram

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[4] Definition of Color Gamut

Measuring machine:CFT-01. NTSC'S Primaries: R(x,y,Y)、G(x,y,Y)、B(x,y,Y).
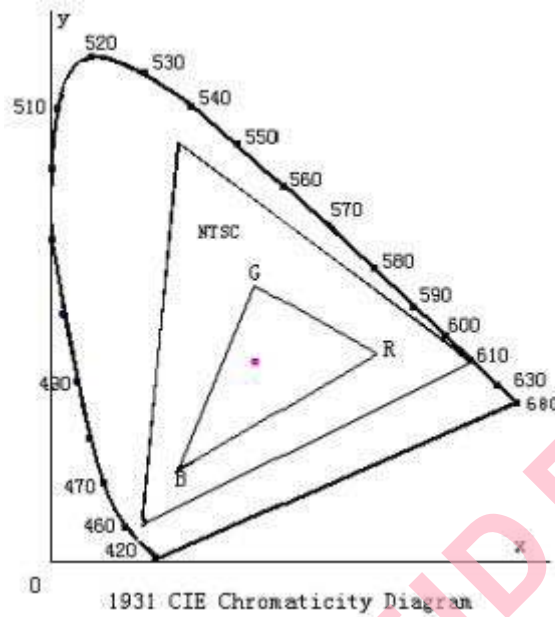
Fig. 1931 CIE chromaticity diagram

Color gamut: $S = \dfrac{Area\ of\ RGB\ triangle}{Area\ of\ NTSC\ triangle} \times 100\%$

[5] Definition of Luminance Uniformity

Active area is divided into 5 measuring areas,every measuring points is placed at the center of each measuring area.
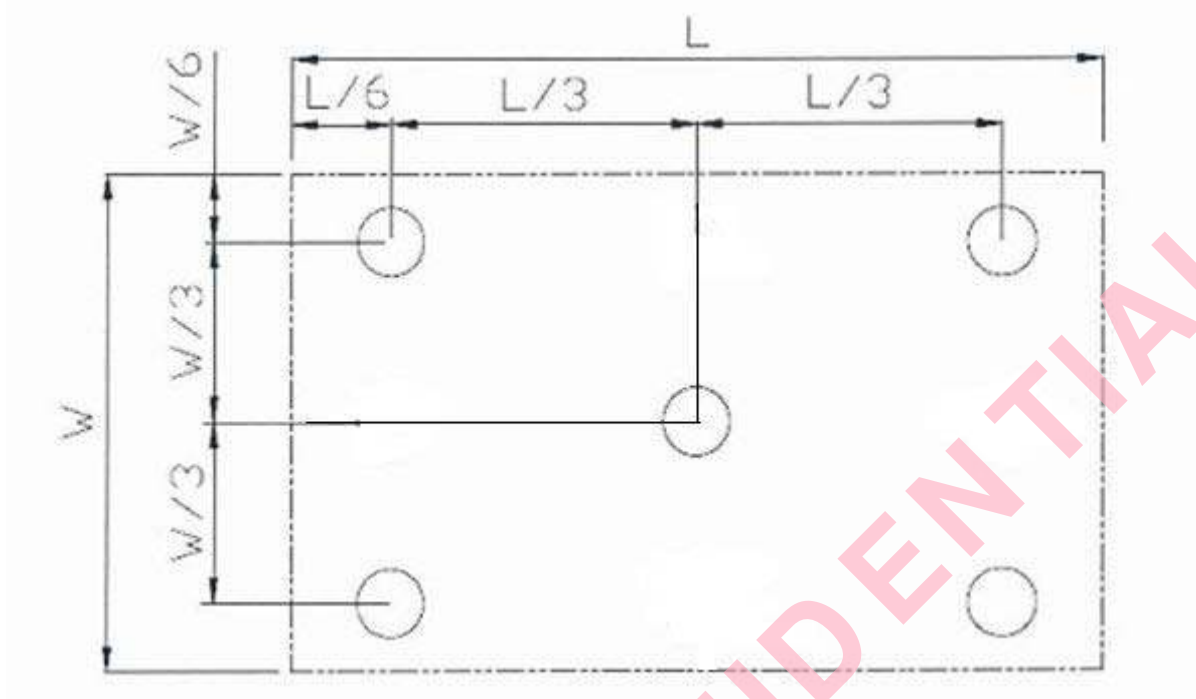
luminance uniformity=Lmin/Lmax.

L:Active area length .

W:Active area width.

Lmax:The measured maximum luminance of all measurement position.

Lmin :The measured minimum luminance of all measurement position.

[6] Definition of Luminance

Measure the luminance of white state at center point.

10. Reliability Test Conditions and Methods

NO.	TEST ITEMS	TEST CONDITION	INSPECTION AFTER TEST
1	High Temperature Storage	80℃×120Hours	Inspection after 2~4hours storage at room temperature,the samples should be free from defects: 1,Air bubble in the LCD. 2,Seal leak. 3,Non-display. 4,Missing segments. 5,Glass crack. 6,Current IDD is twice higher than initial value. 7,The surface shall be free from damage. 8,The electric Characteristic requirements shall be satisfied.
2	Low Temperature Storage	-30℃×120Hours	
3	High Temperature Operating	70℃×120Hours	
4	Low Temperature Operating	-20℃×120Hours	
5	Damp Proof Test (Storage)	60℃×90%RH×120Hours	
6	Temperature Cycling(Storage)	10℃(30min)→25℃(5min)→60℃(30min)→25℃(5min) Cycle:5	
7	ESD（Non-operation）	Air discharge model:±8kV Test nine dots and each dots should be discharged ten times and the interval time can't be less than one second.	

REMARK:

1,The Test samples should be applied to only one test item.

2,Sample for each test item is 5pcs.

3,For Damp Proof Test, Pure water(Resistance＞10MΩ)should be used.

4,In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.

6,Failure Judgment Criterion: Basic Specification Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

11. The Environmental Condition of Inspection：

11.1 The Environmental Condition and Visual Inspection Shall Be Conducted as Below.

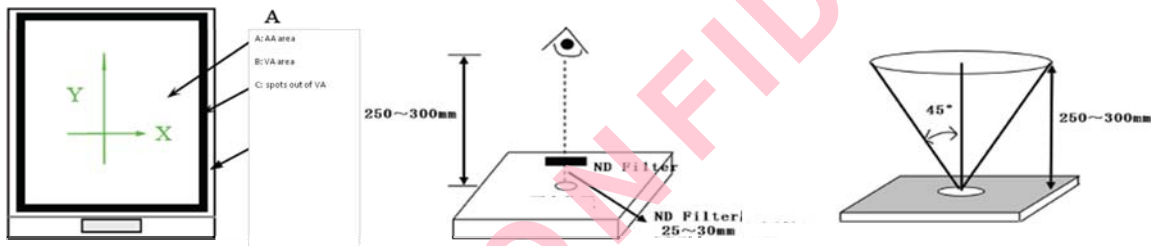11.1.1 Ambient temperature : 22+/-3℃

11.1.2 Humidity: 45~65 %RH

11.1.3 External appearance inspection shall be conducted by using a single 40W fluorescent lamp or equivalent illumination.
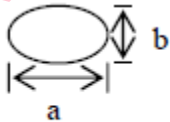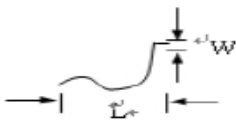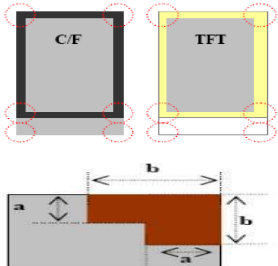
11.1.4 Panel visual inspection on the operation condition for cosmetic shall be conducted at the distance 30~40cm or more between the LCD module and eyes of inspector. And, the viewing angle shall be any angle 45 degree to the front surface of display panel.
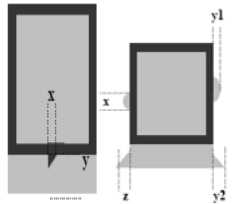
Ambient Illumination: 700 ~ 1000 Lux for external appearance inspection
Ambient Illumination: 100 ~ 200 Lux for display inspection

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11.2.Appearance Inspection

NO	Item	Standards			Remark
		Dimension(mm)	AA/VA area	spots out of VA	
1	Foreign Black/White/ Bright Spot Polarizer Dent/Dent on the Polarizer/ Polarizer Bubble	D≦0.15	Ignore (Not gathered)	Ignore (Not gathered)	
		0.15≤D≦0.3 Distance≧5	N=3		
		D>0.3	Not accepted		
2	Foreign Black/White/ Bright Line Polarizer Scratches	W≦0.03	Ignore (Not gathered)	Ignore	
		0.03≤W≦0.1 L≤2 Distance≧5	N=3		
		W>0.1	Follow spec of dot defects		
3	Any Dirt&Scrarct on Polarizer' Ptotective Film	Ignore for not affect the polarizer			
4	Class Crack	Extended crack is not acceptable			
5	Corner Chip	T=class thinkness accept a≤1mm，b≤3mm，t<T a≤0.5mm，b≤2mm，t=T			

For item 1 remark: $D=(a+b)/2$

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6	Corner Chip on Cap Class	T=class thinkness　accept a＜0.5mm w Ignore，t＜T 0.5≤a≤1mm or w≤3mm，t＜T a≤0.5mm or w≤1.0mm，t=T	
7	Chip on Contact Pad	T=class thinkness　accept a≤0.5mm　　w Ignore，t T (on the contact pin) a≤0.5mm　　w≤3mm，t=T(out of the contact pin)	
8	Chip on The Back of The Pad	T=class thinkness　accept a＜0.5mm w Ignore，t＜T 0.5≤a≤1mm or w≤3mm，t＜T a≤0.5mm or w≤3.0mm，t=T	
9	Chip Overstep The Class	If it doesn't affect assembly or operation, follow the spec below: X　ignore，Y2≤0.5mm，Y2+Z≤0.5	
10	Stain on Surface	Stain removable by soft cloth or air blow is acceptable	

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11.3.Display Inspection

NO	Item	Standards			Remark
		Dimension(mm)	AA/VA area	spots out of VA	
1	Black/White/Bright/Dark Spot	$D \leqq 0.15$	Ignore (Not gathered)	Ignore (Not gathered)	
		$0.15 \leq D \leqq 0.3$ Distance$\geqq 5$	N=3		
		$D > 0.3$	Not accepted		
2	Black/White Line	$W \leqq 0.03$	Ignore (Not gathered)	Ignore	
		$0.03 \leq W \leqq 0.1$ L≤ 2 Distance$\geqq 5$	N=3		
		$W > 0.1$	Follow spec of dot defects		
3	No Display	Not accepted			
4	Irregular Display	Not accepted			
5	Missing Line	Not accepted			
6	Short	Not accepted			
7	Flicker	Not accepted			

12. Handling Precautions

12.1 Mounting Method

12.1.1 The LCD panel of LCD module consists of two thin glass plates with polarizes which easily be amaged.

12.1.2 And since the module in so constructed as to be fixed by utilizing fitting holes in the printed circuit board.

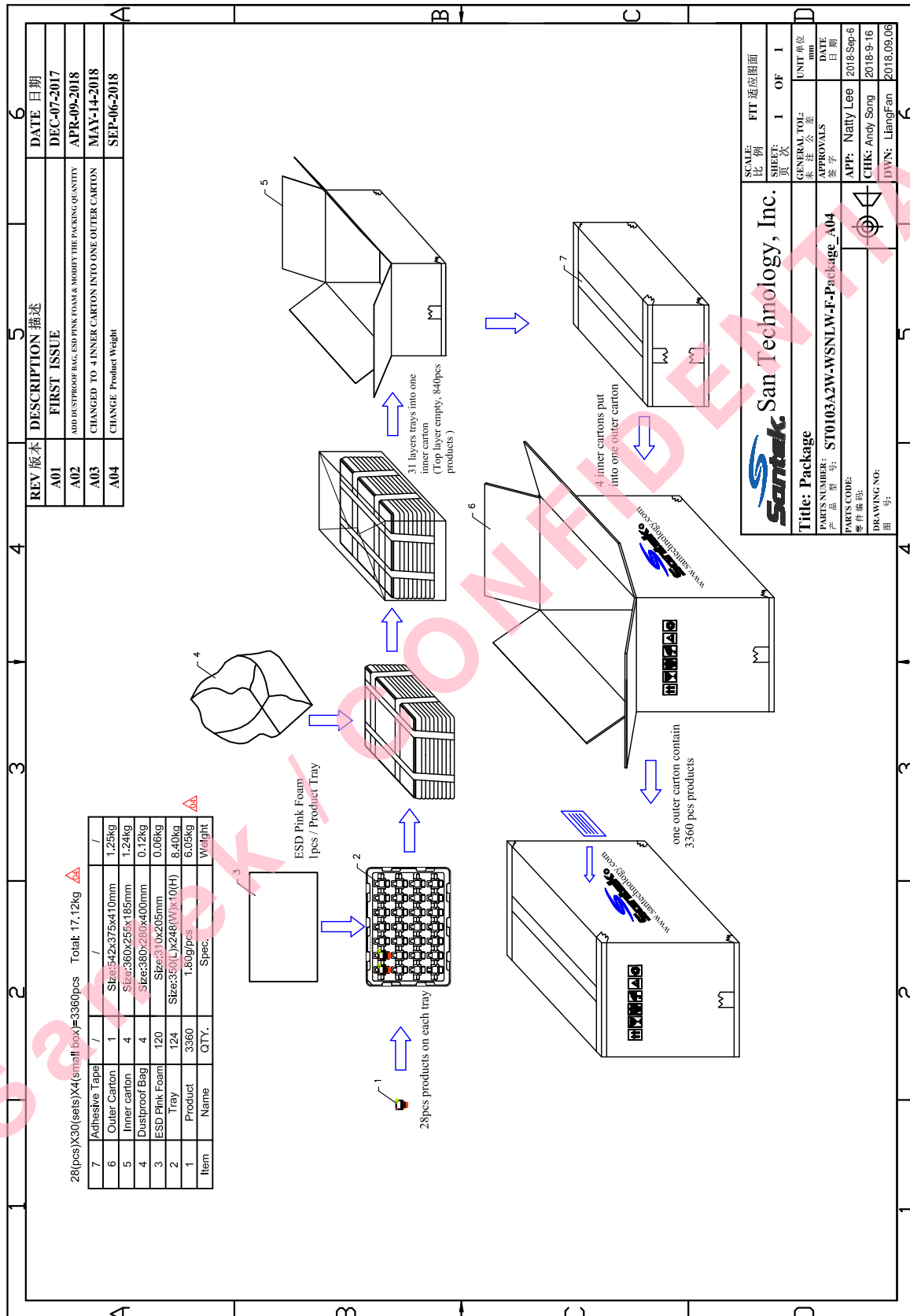12.1.3 Extreme care should be needed when handling the LCD modules.

12.2 Caution of LCD Handling and Cleaning

12.2.1 When cleaning the display surface, Use soft cloth with solvent [recommended below] and wipe lightly:

Isopropyl alcohol

Ethyl alcohol

12.2.2 Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

12.2.3 Do not use the following solvent:

Water

Aromatics

12.2.4 Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns

12.2.5 Do not use the following solvent on the pad or prevent it from being contaminated:

Soldering flux

Chlorine (Cl) , Salfur (S)

12.2.6 If goods were sent without being sili8con coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

12.2.7 If ITO corrosion happen by miss-handling or using some materials such as Chlorine (CI), Salfur (S) from customer, responsibility is on customer.

12.3 Caution Against Static Charge

12.3.1 The LCD module use C-MOS LSI drivers, so we recommended that you.

12.3.2 Connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

12.3.3 Module employ LCD elements and must be treated as such.

12.3.4 Avoid intense shock and falls from a height.

12.3.5 To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

12.4 Packing

REV 版本	DESCRIPTION 描述	DATE 日期
A01	FIRST ISSUE	DEC-07-2017
A02	ADD DUSTPROOF BAG, ESD PINK FOAM & MODIFY THE PACKING QUANTITY	APR-09-2018
A03	CHANGED TO 4 INNER CARTON INTO ONE OUTER CARTON	MAY-14-2018
A04	CHANGE Product Weight	SEP-06-2018

28(pcs)X30(sets)X4(small box)=3360pcs   Total: 17.12kg

Item	Name	QTY.	Spec.	Weight
7	Adhesive Tape	/	/	/
6	Outer Carton	1	Size:542x375x410mm	1.25kg
5	Inner carton	4	Size:360x255x185mm	1.24kg
4	Dustproof Bag	4	Size:380x280x400mm	0.12kg
3	ESD Pink Foam	120	Size:310x205mm	0.06kg
2	Tray	124	Size:350(L)x248(W)x10(H)	8.40kg
1	Product	3360	1.80g/pcs	6.05kg

ESD Pink Foam
1pcs / Product Tray

28pcs products on each tray

31 layers trays into one inner carton
(Top layer empty, 840pcs products)

4 inner cartons put into one outer carton

one outer carton contain 3360 pcs products

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SCALE 比例	FIT 适应图面	UNIT 单位 mm
GENERAL TOL: 未注公差	SHEET: 页次 1 OF 1	DATE 日期
APPROVALS 签字	APP: Natty Lee	2018-Sep-6
	CHK: Andy Song	2018-9-16
	DWN: LiangFan	2018.09.06

San Technology, Inc.

Title: **Package**

PARTS NUMBER: 产品型号: **ST0103A2W-WSNLW-F-Package_A04**

PARTS CODE: 零件编码:

DRAWING NO: 图号:

12.5 Caution for Operation

12.5.1 It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life.

12.5.2 An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.

12.5.3 Response time will be extremely delayed at lower temperature then the operating temperature range and on the other hand at higher temperature LCD's how dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.

12.5.4 If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.

12.5.5 A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

12.5.6 Usage under the maximum operating temperature, 50%Rh or less is required.

12.6 Storage

12.6.1 In the case of storing for a long period of time for instance, for years for the purpose or replacement use, the following ways are recommended.

12.6.2 Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it . And with no desiccant.

12.6.3 Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.

12.6.4 Storing with no touch on polarizer surface by the anything else.

12.6.5 It is recommended to store them as they have been contained in the inner container at the time of delivery from us.

12.7 Safety

12.7.1 It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.

12.7.2 When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

13. Precaution for Use

13.1 A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity.

13.2 Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

13.3 On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

13.4 When a question is arisen in this specification.

13.5 When a new problem is arisen which is not specified in this specifications.

13.6 When an inspection specifications change or operating condition change in customer is reported to GT LCD,and some problem is arisen in this specification due to the change.

13.7 When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.