

**SPECIFICATION
FOR
LCD Module**

Customer P/N:

Santek P/N: ST0144A1W-RSLW-F

DOC. Revision: RS01

Customer Approval:

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	SIGNATURE	DATE
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Document Revision History

Version	Revise Date	Description	Changed by
RS01	2018-03-21	Initial release	Vivian Huang

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1. GENERAL SPECIFICATION

1.1. DESCRIPTION

The ST0144A1W-RSLW-F is a color active matrix Thin Film Transistor (TFT) Liquid Crystal Display (LCD) that uses amorphous silicon(a-Si) TFT as a switching device. This model is composed of a single **1.44** inches transmissive type main TFT-LCD panel. The resolution of the panel is **128RGB x 128** pixels and can display up to **262K** color.

1.2. FEATURE

- TM type for main TFT-LCD panel
- Structure COG+FPC+BL
- Full, Normal (Still), Partial, Sleep, Standby mode are available

1.3. APPLICATION

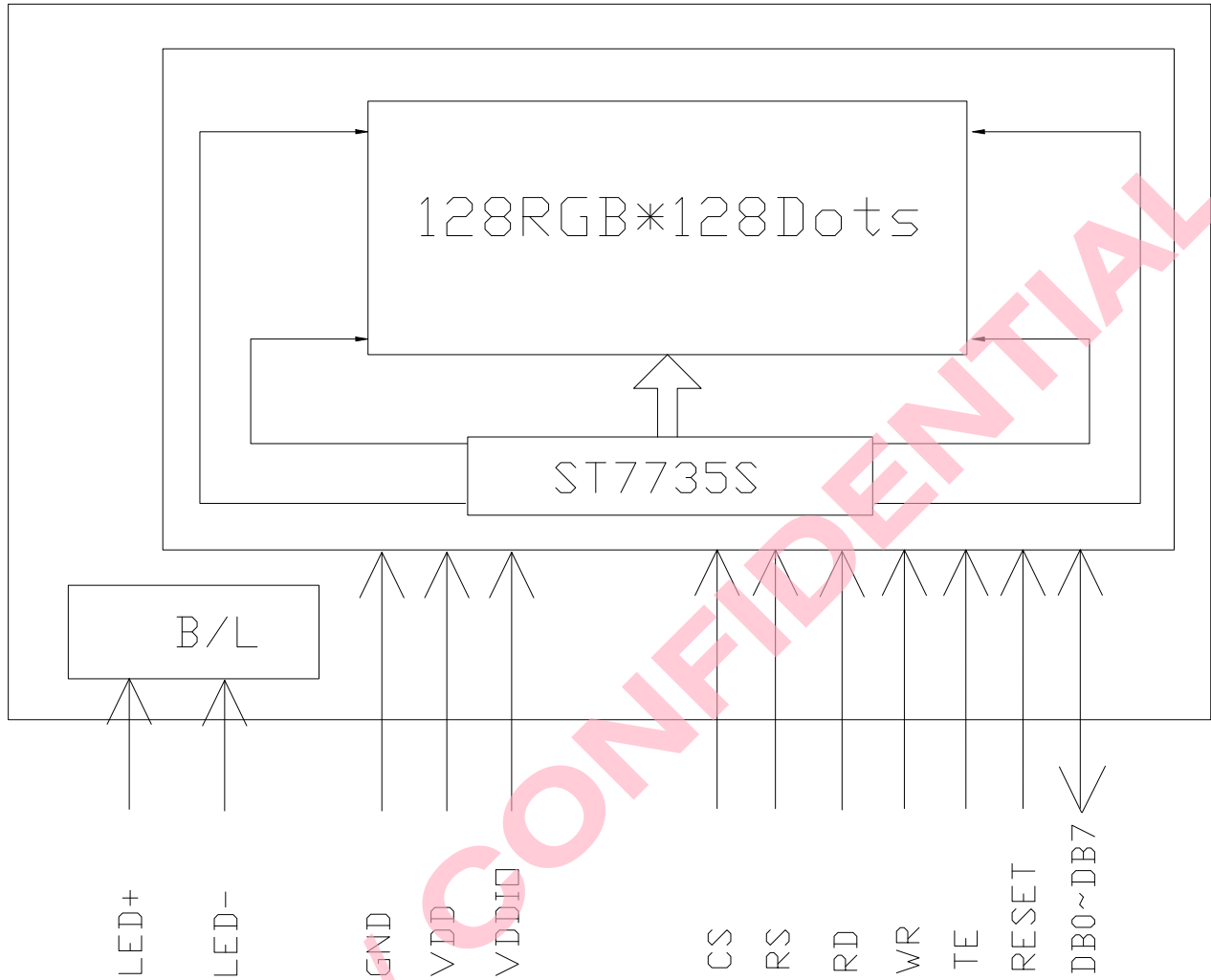
- Display terminals for cellular phone

1.4. GENERAL SPECIFICATION

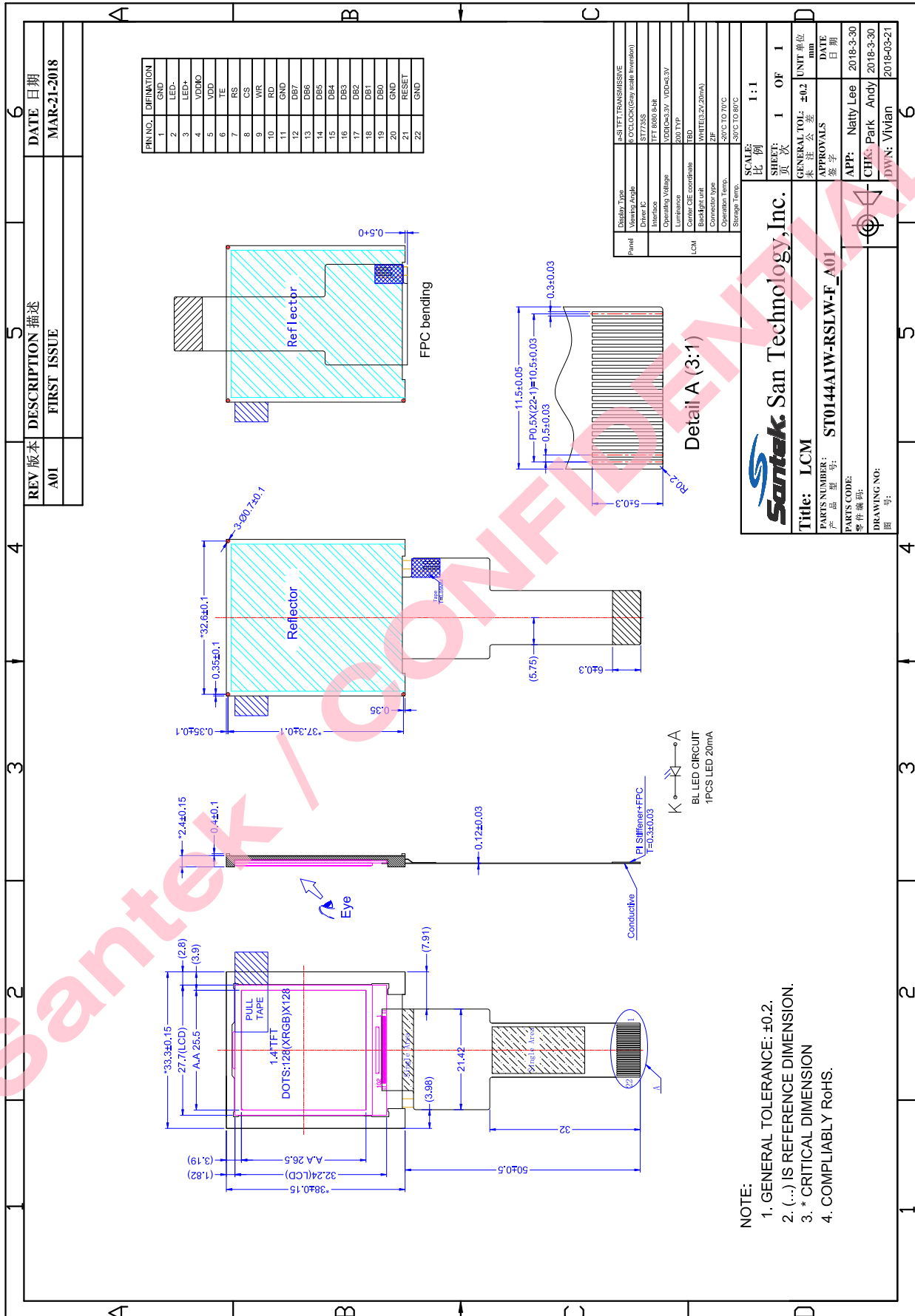
No.	Item	Specification	Unit	Remark
1	LCD Size	1.44	inch	-
2	Panel Type	a-Si TFT active matrix	-	-
3	Resolution	128 x (RGB) x 128	pixel	-
4	Display Mode	Normally white, Transmissive	-	-
5	Display Number of Colors	262k	-	-
6	Viewing Direction	6 o'clock(Good View Direction)	-	Note
7	Contrast Ratio	400(Typ)	-	-
8	Luminance	200(Typ)	cd/m ²	-
9	Module Size	33.3(W) x 38.0(L) x 2.4(T)(Not Include FPC)	mm	Note
10	Active Area	25.5(W) x 26.5(L)	mm	Note
11	Pixel Pitch	0.1992(W) x 0.207 (L)	mm	-
12	Weight	4.5	g	-
13	Driver IC	ST7735S	-	-
14	Driver IC RAM Size	132x18x162	bit	-
15	Light Source	1 LED White	-	-
16	Interface	8080 8 bit Parallel	-	-
17	Operating Temperature	-20~70	°C	-
18	Storage Temperature	-30~80	°C	-

Note: Please refer to the mechanical drawing.

2. BLOCK DIAGRAM



3. MECHANICAL DRAWING

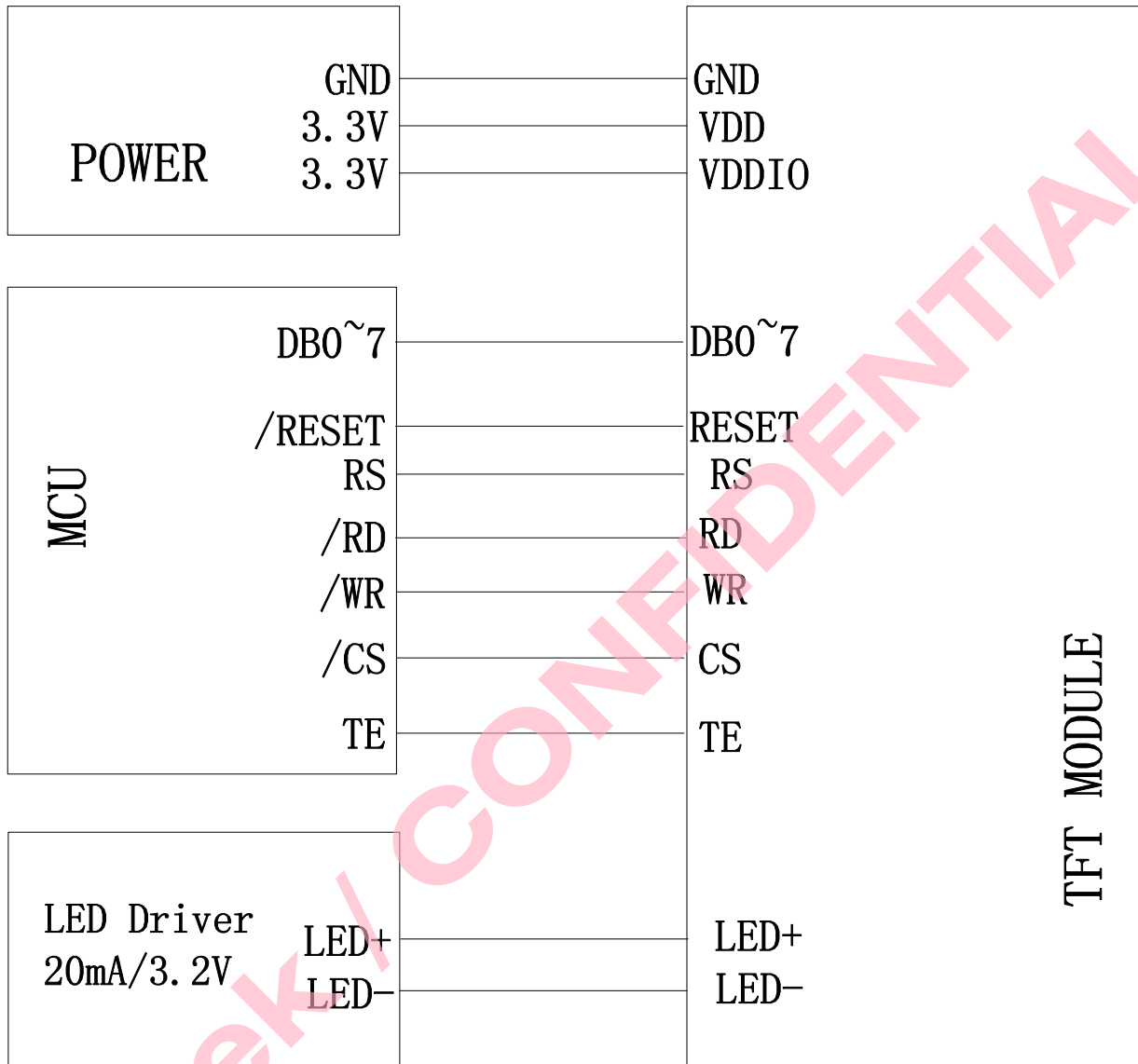


4. INTERFACE ASSIGNMENT

PIN NO.	SYMBOL	FUNCTION DESCRIPTIONS
1	GND	Ground.
2	LED-	Power supply for backlight (cathode).
3	LED+	Power supply for backlight (anode).
4	VDDIO	Power supply for I/O interface.
5	VDD	Power supply for analog.
6	TE	Tearing effect output pin to synchronies MCU to frame rate, activated by S/W command. If not used, please open this pin.
7	RS	Display data/command selection pin in parallel interface. RS=0:command data. RS=1:display data or parameter.
8	CS	Chip Selection Pin. Low Enable.
9	WR	Write enable in MCU parallel interface.
10	RD	Read enable in MCU parallel interface.
11	GND	Ground.
12	DB7	Data bus.
13	DB6	Data bus.
14	DB5	Data bus.
15	DB4	Data bus.
16	DB3	Data bus.
17	DB2	Data bus.
18	DB1	Data bus.
19	DB0	Data bus.
20	GND	Ground.
21	RESET	This signal will reset the device and it must be applied to properly initialize the chip. Signal is active low.
22	GND	Ground.

5. ELECTRICAL SPECIFICATION

5.1. APPLICATION CIRCUIT



5.2. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN	TYP	MAX	
Power Supply for Analog	VDD	Ta=25 °C	-0.3	-	4.8	V
Power Supply for I/O Interface	VDDIO		-0.3	-	4.6	

Note: Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is applied.

5.3. TYPICAL OPERATION CONDITION

5.3.1 DC CHARACTERISTICS

ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN	TYP	MAX	
Power Supply for Analog	VDD	Ta=25 °C	2.5	3.3	3.6	V
Power Supply for I/O Interface	VDDIO	Ta=25 °C	1.65	3.3	3.6	
Input Signal "H" Level	VIH	-	0.7VDDIO	-	VDDIO	V
Input Signal "L" Level	VIL	-	GND	-	0.3VDDIO	V
Output Signal "H" Level	VOH	IOH=-1.0mA	0.8VDDIO	-	VDDIO	V
Output Signal "L" Level	VOL	IOL=1.0mA	GND	-	0.2VDDIO	V
Frame Frequency	f _{FRAME}	-	55	60	85	Hz

Note: To prevent IC latch up or DC operation in LCD panel, the power on/off sequence should follow the driver IC specification.

5.3.2 CURRENT CONSUMPTION

Item	Symbol	Values		Unit	Remark
		type	Max.		
RGB-SPI 24-bit Interface					
Normal(Still) Mode	I _{CC1}	1.8	2.5	mA	Note1
Standby Mode	I _{CC1}	15	30	uA	Note2

Note1: Test Condition

Typ: VDD=3.3V

TFT Display Pattern: All Pixel Black

TFT Frame Rate=60Hz at Column Inversion

Operating Temperature: 25°C

Max. current check pattern:

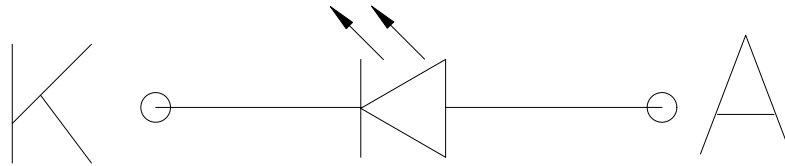


Black

Note2: In the standby mode, all the internal display operations are suspended including the internal R-C oscillator.

5.4. BACKLIGHT SPECIFICATION

5.4.1 BACKLIGHT CIRCUIT



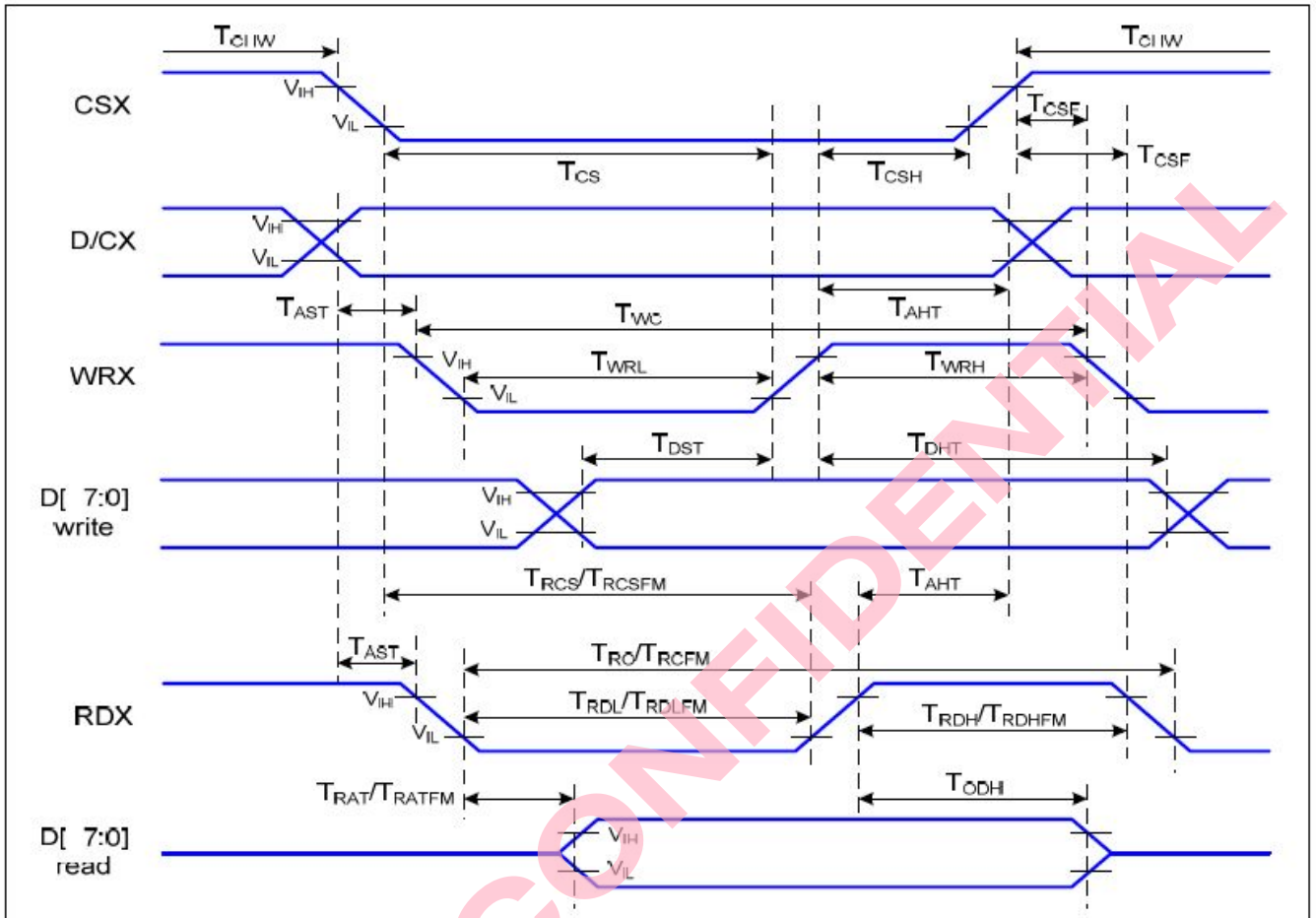
5.4.2 ELECTRICAL CHARACTERISTICS

(T=25°C)

PARAMETER	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN	TYP	MAX	
FORWARD CURRENT	VF	IF=20mA	2.8	3.2	3.4	v

5.5. INTERFACE TIMING CHARACTERISTICS

8080 Series MCU Parallel 8-bit Interface Characteristics



Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	TAST	Address Setup Ttime	0		ns	-
	TAHT	Address Hold Time (Write/Read)	10		ns	
CSX	TCHW	Chip Select "H" Pulse Width	0		ns	-
	TCS	Chip Select Setup Time (Write)	15		ns	
	TRCS	Chip Select Setup Time (Read ID)	45		ns	
	TRCSFM	Chip Select Setup time (Read FM)	355		ns	
	TCSF	Chip Select Wait Time (Write/Read)	10		ns	
	TCSH	Chip Select Hold Time	10		ns	
WRX	TWC	Write Cycle	66		ns	-
	TWRH	Control Pulse "H" Duration	15		ns	
	TWRL	Control Pulse "L" Duration	15		ns	
RDX (ID)	TRC	Read Cycle (ID)	160		ns	When Read ID Data
	TRDH	Control Pulse "H" Duration (ID)	90		ns	
	TRDL	Control Pulse "L" Duration (ID)	45		ns	

RDX (FM)	TRCFM	Read Cycle (FM)	450		ns	When Read from Frame Memory
	TRDHFM	Control Pulse "H" Duration (FM)	90		ns	
	TRDLFM	Control Pulse "L" Duration (FM)	355		ns	
D[7:0]	TDST	Data Setup Time	10		ns	For CL=30pF
	TDHT	Data Hold Time	10		ns	
	TRAT	Read Access Time (ID)		40	ns	
	TRATFM	Read Access Time (FM)		340	ns	
	TODH	Output Disable Time	20	80	ns	



Figure 2 Rising And Falling Timing for Input And Output Signal

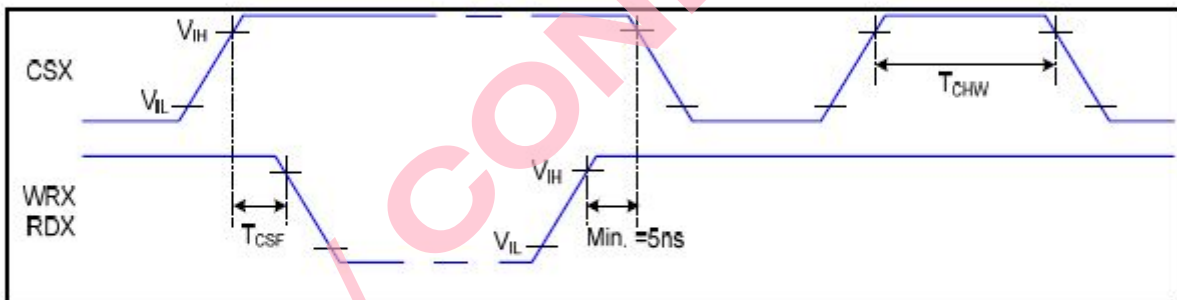


Figure 3 Chip Selection (CSX) Timing

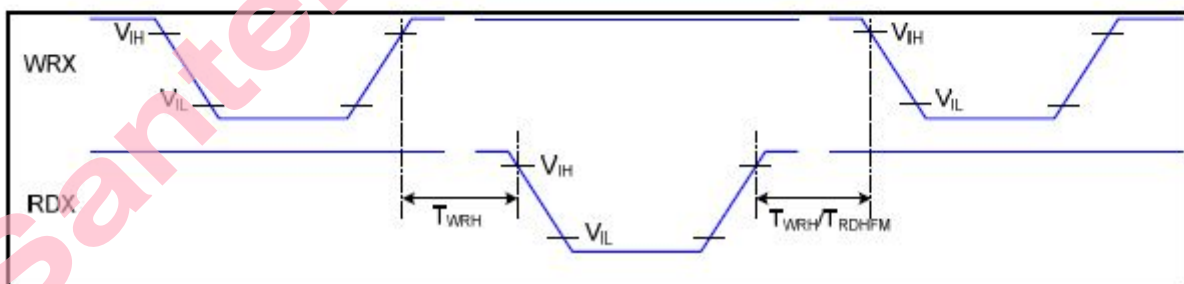
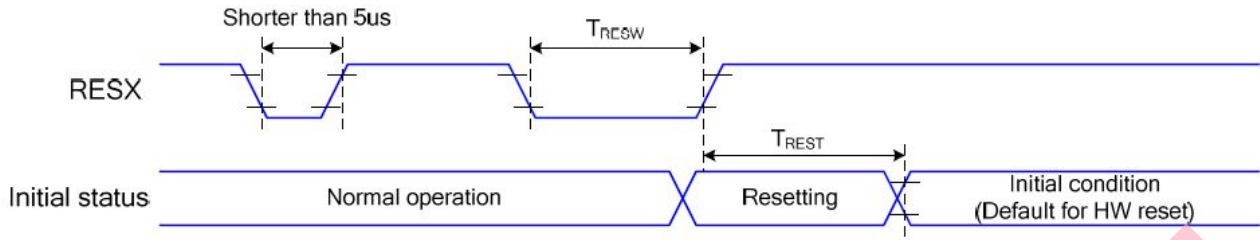


Figure 4 Write-to-Read And Read-to-Write Timing

Note: The rising time and falling time (T_r , T_f) 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.

5.6. RESET TIMING CHARACTERISTICS



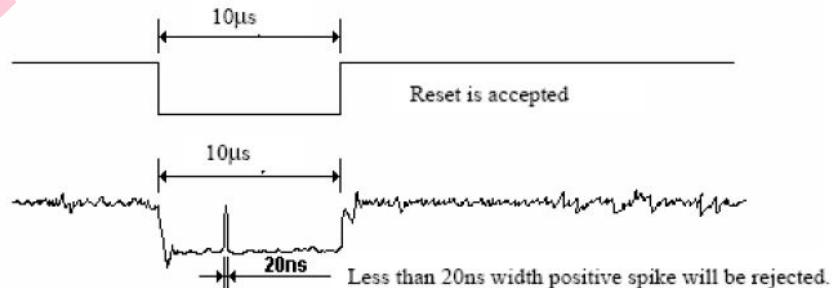
Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	tRESW	Reset Pulse Duration	10	-	us
	tREST	Reset Cancel	-	5	ms
			-	120	ms

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset Starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In -mode.) and then return to Default condition for Hardware Reset.
4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

6. OPTICAL CHARACTERISTICS

($T_a=+25^{\circ}\text{C}$, $V_{CI}=+2.85\text{V}$ $I_{OVCC}=+1.8\text{V}$, $I_B=20\text{mA}$)

Item		Symbol	Condition	Values			Unit	Remark
				Min.	Typ.	Max.		
Viewing Angle Range	Left	θ_L	$CR \geq 10$	50	60	-	degree	Note 1,2
	Right	θ_R		50	60	-		
	Top	Φ_T		55	65	-		
	Bottom	Φ_B		30	40	-		
Response Time		$T_{on} + T_{off}$	Normal $\theta = \phi = 0^{\circ}$	-	25	-	ms	Note 2,3
Contrast Ratio		CR	Normal $\theta = \phi = 0^{\circ}$	-	400	-	-	Note 2,4
Luminance		L	Normal $\theta = \phi = 0^{\circ}$	180	200	-	cd/m ²	Note 2,5
Color Chromaticity (CIE1931)	White	W_x	Normal $\theta = \phi = 0^{\circ}$	0.23	0.28	0.33	-	Note 2,6
		W_y		0.24	0.29	0.34		
	Red	R_x		0.55	0.60	0.65		
		R_y		0.26	0.31	0.36		
	Green	G_x		0.25	0.30	0.35		
		G_y		0.57	0.62	0.67		
	Blue	B_x		0.09	0.14	0.19		
		B_y		0.05	0.1	0.15		
Color Gamut		NTSC	CIE1931	-	53	-	%	-
Luminance Uniformity		U_L	Normal $\theta = \phi = 0^{\circ}$	70	80		%	Note 2,7

Note 1: Definition of viewing angle range

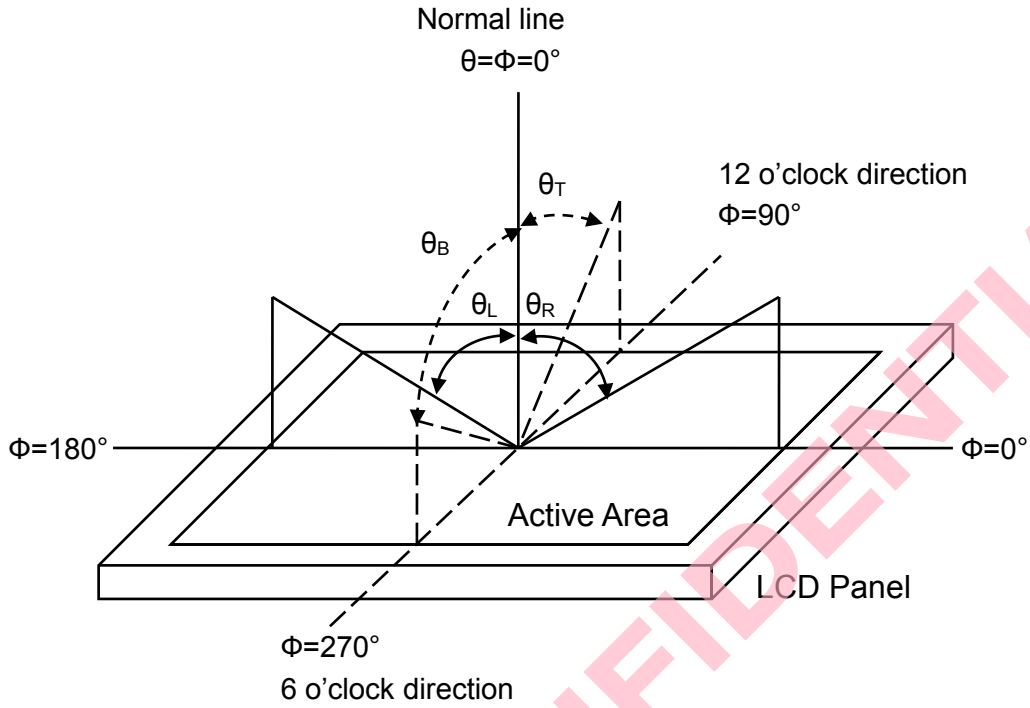


Fig. 1 Definition of viewing angle

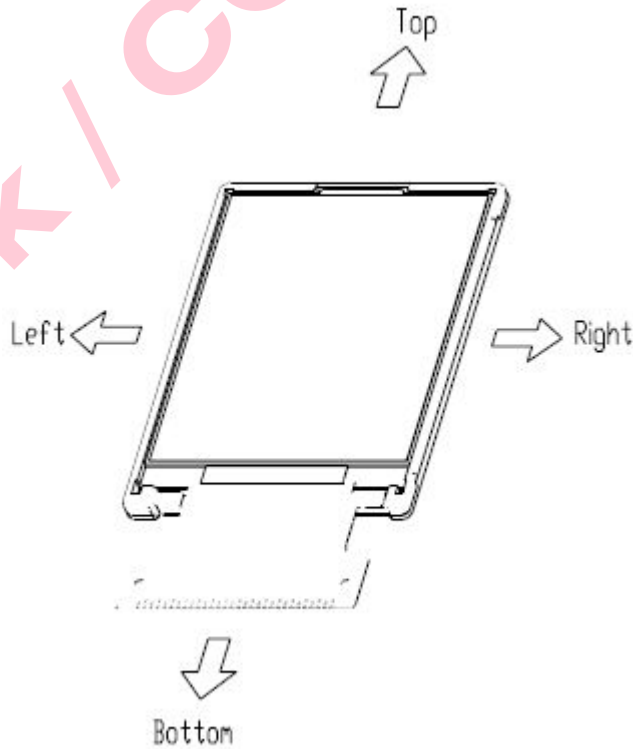


Fig. 2 Definition of viewing angle for display

Note 2: Definition of optical measurement system

The optical characteristics should be measured in a dark room with ambient temperature $T_a=+25\text{ }^\circ\text{C}$. The optical properties are measured at the center point of the LCD screen after 5 minutes operation. (Equipment: Photo detector TOPCON BM-7AS Field of view: 1° /Height: 500mm.)

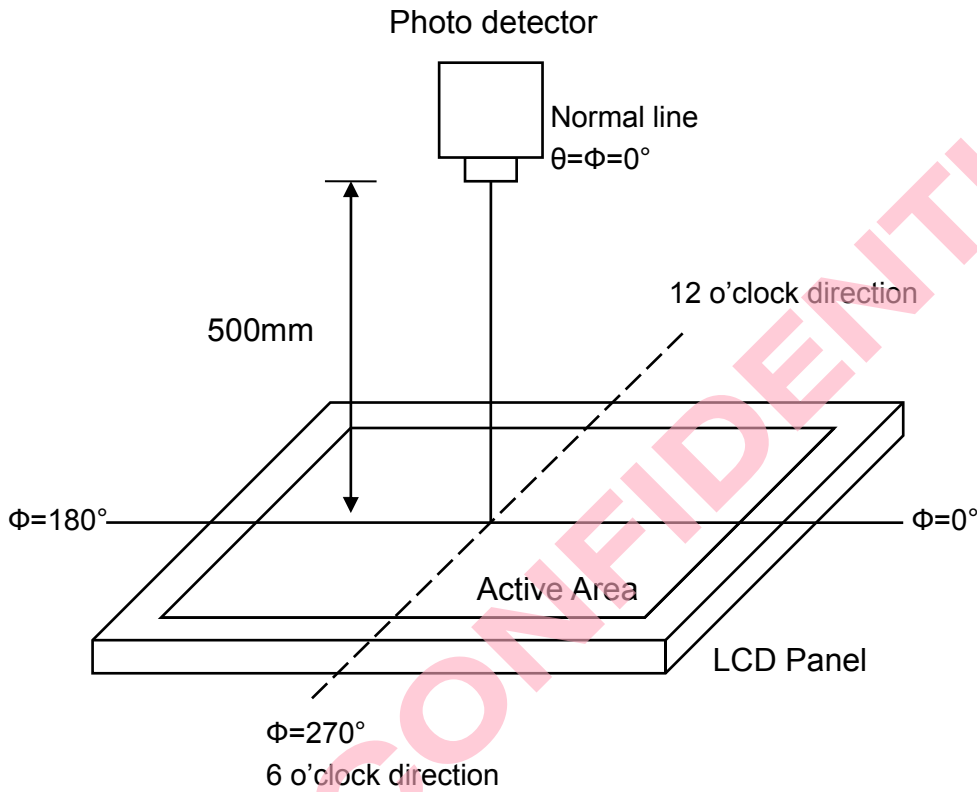


Fig. 3 Optical measurement system setup

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 (T_{on}) is the time between photo detector output intensity changed from 90% to 10%, and fall time (T_{off}) is the time between photo detector output intensity changed from 10% to 90%.

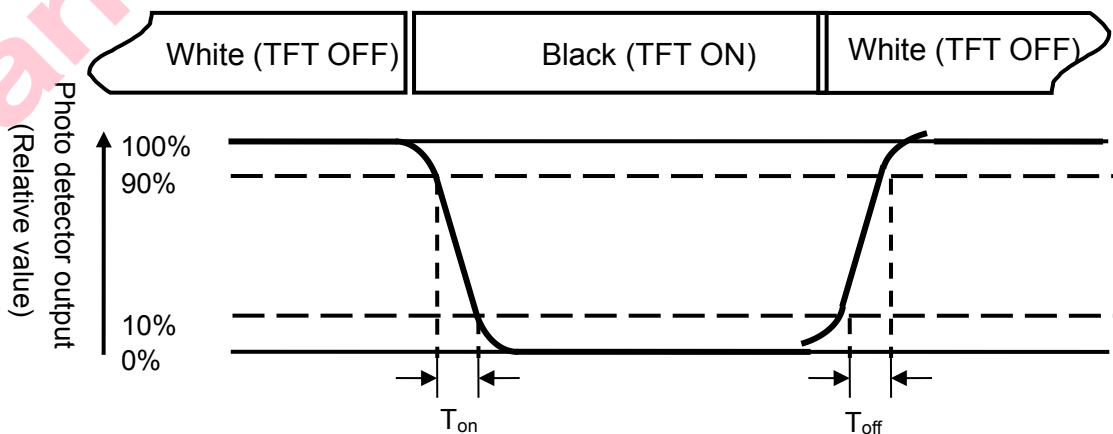


Fig. 4 Definition of response time

Note 4: Definition of contrast ratio

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

Note 5: Definition of luminance

Measured at the center area of the panel when LCD panel is driven at "white" state.

Note 6: Definition of color chromaticity (CIE1931)

Color coordinates measured at the center point of LCD when panel is driven at "White", "Red", "Green" and "Blue" state respectively.

Note 7: Definition of luminance uniformity

To test for uniformity, the tested area is divided into 3 rows and 3 columns. The measurement spot is placed at the center of each circle as below.

$$\text{Luminance Uniformity (U}_L\text{)} = \frac{L_{\min}}{L_{\max}}$$

L-----Active area length W----- Active area width

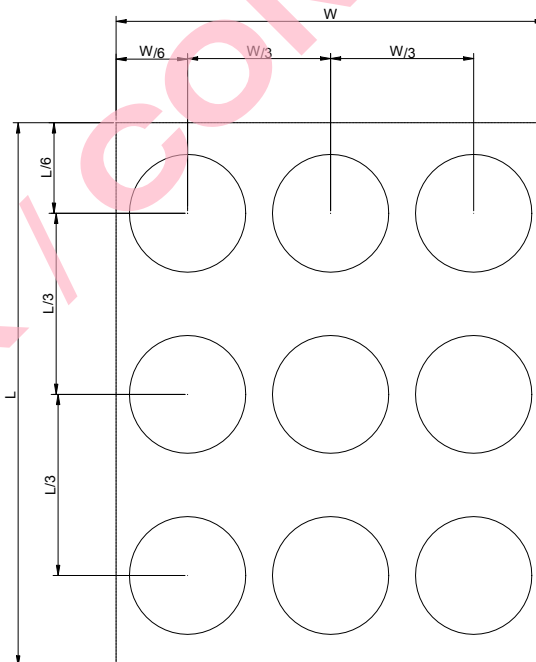


Fig. 5 Definition of luminance uniformity

L_{\min} : The measured minimum luminance of all measurement position.

L_{\max} : The measured maximum luminance of all measurement position.

7. RELIABILITY TESTS

ITEM	CONDITION	CRITERION
Operating Temperature Test	High Temperature: +70 °C±3°C, 120 hrs	No defects in display and operational functions
	Low Temperature: -20 °C±3°C, 120 hrs	
Storage Temperature Test	High Temperature: +80 °C±3°C, 120hrs	No defects in display and operational functions
	Low Temperature: -30 °C±3°C, 120 hrs	
Humidity Endurance Test	60 °C±3°C, 90%±3%RH, 72 hrs	No defects in display and operational functions
Thermal Shock Test	-30 °C (30mins)~ +80 °C (30mins) 14 cycles	No defects in display and operational functions
Vibration Resistance Test	Operating Time: thirty minutes exposure for each direction (X,Y,Z) Sweep Frequency: 10~55Hz (1 min) Amplitude: 1.5mm	No defects in display and operational functions
Mechanical Shock	Height :76cm (Weight ≤9.5kg); 61cm(9.5<Weight ≤18.6kg) 1 corner, 3 edges, 6 surfaces	No defects in display and operational functions

NOTE:

- 1) The samples must be free from defect before test, must be restored at room condition at least for 2 hours after reliability test before any inspection.
- 2) Before test the function of TP, the sample must be placed in room temperature for 24hrs after RA test.

8. PRECAUTIONS

8.1. HANDLING

- 9.1.1. Polarizer cleaning, Petroleum ether (or N-hexane) is recommended for cleaning the front/rear polarizers and reflectors, acetone, toluene and ethanol are not allowed to avoid damaging the surface.
- 9.1.2. Body grounding, must wear Anti-ESD wrist strap while pick up LCDs.
- 9.1.3. FPC soldering, less than 300°C/3S, solder must be grounding on grounding bench.
- 9.1.4. If use electric Screwdriver to do assembly, screwdriver must be grounding.

8.2. STORAGE

- 9.2.1. Keep in a sealed polyethylene bag.
- 9.2.2. Keep in a dark place.
- 9.2.3. Keep in temperature between 0°C and 35°C.
NOT allowed at 70°C for more than 160 Hours, or at -20°C for more than 48 Hrs.

8.3. SAFETY

If liquid crystal leak out of a damaged glass cell, **DO NOT** put it in your mouth or touch eyes, if the liquid crystal touch your skin or clothes, please wash it off immediately using soap and water.

9. 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 above. Santek shall not be responsible for any subsequent or consequential events.

9.1. RETURNING LCM UNDER WARRANTY – TERMS AND CONDITIONS

- 9.1.1. 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.
- 9.1.2. 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.