PRELIMINARY SPECIFICATION

MODEL NO.: ST-TFT231A07
VERSION: A
ISSUED DATE: 2021.5.26

Victor Display:

PREPARED BY	CHECKED BY	APPROVED BY

Customer:_____

APPROVED BY	NOTES

DOCUMENT REVISION HISTORY

REVISION	DATE	DESCRIPTION	CHANGED BY	CHECKED BY
A	2021.5.26	First Release.	CY	

CONTENTS

		Page No.
1.	GENERAL DESCRIPTION	4
2.	MECHANICAL SPECIFICATIONS	4
3.	INTERFACE SIGNALS	6
4.	ABSOLUTE MAXIMUM RATINGS	7
4.1	ELECTRICAL MAXIMUM RATINGS - FOR IC ONLY	7
4.2	ENVIRONMENTAL CONDITION	7
4.3	BACKLIGHT SPECIFICATIONS	7
5.	ELECTRICAL SPECIFICATIONS	8
5.1	TYPICAL ELECTRICAL CHARACTERISTICS	8
5.2	TIMING SPECIFICATION	9
5.2.1	4-LINE SPI INTERFACE TIMING CHARACTERISTICS	9
5.2.2	RESET INPUT TIMING	11
6.	OPTICAL CHARACTERISTICS	12
7.	TFT INSPECTION SPECIFICATION	14
8.	REMARK	16

1. General Description

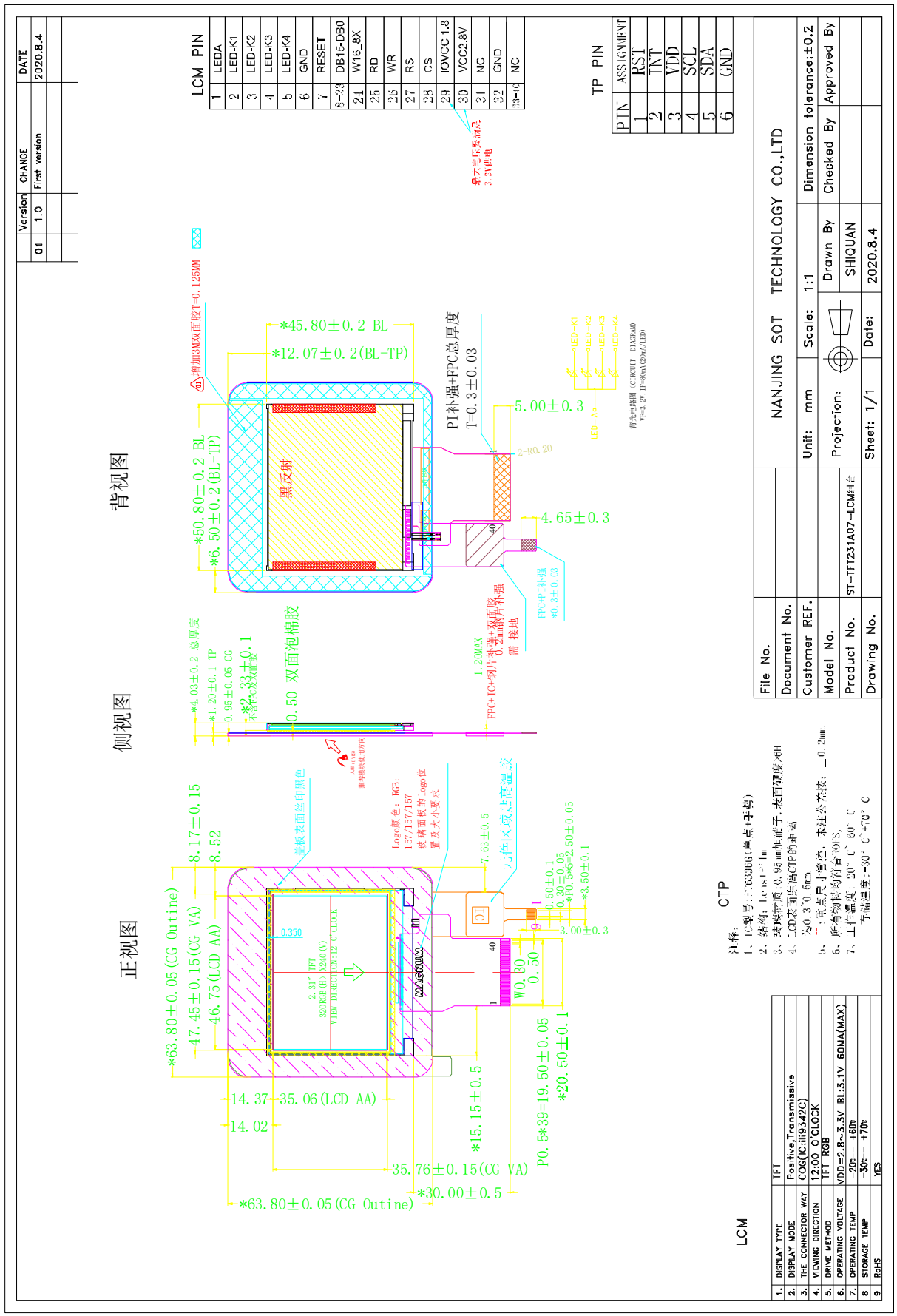
- 2.31″, 320×RGB×240 dots, 262K-colors, TFT, transmissive, dot matrix LCD module.
- Pixel Configuration: R.G..B. Vertical Stripe
- Viewing angle: 12:00
- Driving IC: ILI9342
- Data interface: 8080 MCU interface
- Logic voltage/Analog voltage: 1.8-3.3V.
- White LED backlight.
- FPC connection.
- With CTP.
- “RoHS” compliance.

2. Mechanical Specifications

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

Table 1

Parameter		Specifications	Unit
Outline dimensions		63.8(H) x63.8(V) x 4.03(D)	mm
Color TFT	Active area	46.75(H) x 35.06(V)	mm
	Display format	320 x RGB x 240	dots
	Color configuration	RGB stripe	-
	Dot pitch	0.1461RGB (V) x0.1461(H)	mm
Weight		TBD	g


正视图
侧视图
背视图
LCM
CTP
LCM PIN
TP PIN
NANJING SOT TECHNOLOGY CO.,LTD
ST-TFT231A07-LCM封存
SHIQUAN
2020.8.4

3 Interface signals

Table Pin assignment

Pin No.	Symbol	Description
1	LEDA	Anode of LED backlight. 3.3V ,60MA(MAX)
2-5	LEDK1-K4	Cathode of LED backlight.
6	GND	Power Ground.
7	/RESET	This signal will reset the device and must be applied to properly initialize the chip.
8-23	DB15-DB0	16-bit parallel bi-directional data bus for MPU system interface mode
24	W16/8X	W16/8X=0, 80 MCU 8-bit bus interface,DB7-DB0 is use, W16/8X=1, 80 MCU 16-bit bus interface-DB15-DB0 is use. Fix to GND level when not in use.
25	RD	In 80-system mode, this serves as a read strobe signal.
26	WR	In 80-system mode, this serves as a write strobe signal.
27	RS	A register select signal Low: select an index or status register High: select a control register
28	/CS	Chip select signal. Low: chip is selected and accessible. High: chip is not selected and not accessible.
29	IOVCC	MPU power supply voltage: 1.8-3.3V.
30	VDD	Analog power supply voltage: 2.6-3.3V.
31	NC	NC
32	GND	Power Ground.
33-40	NC	NC

4. Absolute Maximum Ratings

4.1 Electrical Maximum Ratings – for IC Only

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

Table 3

Items	Symbol	Condition	Min.	Max.	Unit	Note
Power Voltage	VCI	GND=0	-0.3	3.3	V	
Operating Temperature	T_{OP}	-	-20	60	℃	Ambient temperature
Storage Temperature	T_{ST}	-	-30	70	℃	Ambient temperature

Note：

1) All the voltages listed above are with respective to GND=0V。
2) Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above。
3) * TA≦40℃ Without dewing。

4.2 Environmental Condition

Table 4

No.	Test Item*	Test Condition	Check Time
1	High Temp Storage	Ta=70℃	24hrs
2	Low Temp Storage	Ta=-30℃	24hrs
3	High Temp Operation	Ta=60℃	24hrs
4	Low Temp Operation	Ta=-20℃	24hrs
5	High Temp & High Humidity Operation	Ta=40℃ H=90%RH	24hrs

Note: 1. Ta: Ambient temperature.
2. All judgments of display are performed after temp of panel returns to room temperature.
3. Display function should be no change under normal operating condition.
4. Under no condensation of dew.

4.3 Backlight Characteristics

项目 Item		符号 Symbol	最小值 min.	典型值 typ.	最大值 max.	单位 Unit	测定条件 Condition
	亮度 Luminance	Lv	200	230		cd/m²	If= 15*4 mA (恒定电流测试)
	均匀性 Uniformity	Avg	—	80%	—	%	
	色度坐标 Colour Coordinate	X	0.250		0.310		
		Y	0.250		0.310		
	亮度 Luminance	Lv				cd/m²	
	均匀性 Uniformity	Avg				%	
	色度坐标 Colour Coordinate	X					
		Y					
正向电压 Forward Voltage		Vf	2.9	3.3	3.4	V	
反向漏电电流 Reverse Current		Ir				μA	

5.Electrical Specifications

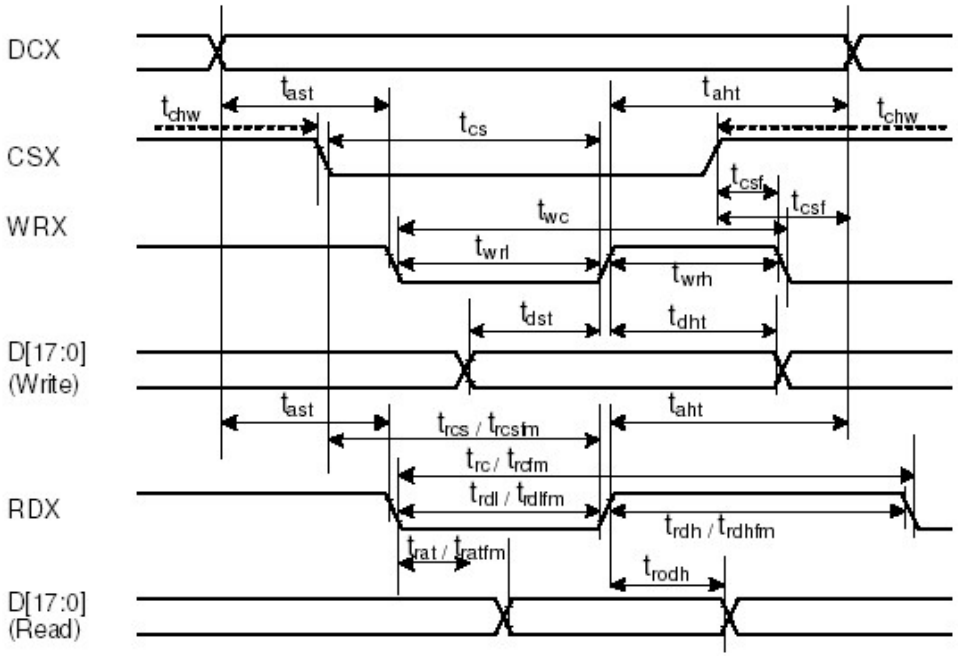
5.1 Typical Electrical Characteristics

Table 5

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.	Note
Input high voltage	V_{IH}	V	IOVcc = 1.65V ~ 3.3 V	0.8* IOVcc	-	IOVcc	2,3
Input low voltage	V_{IL}	V	IOVcc = 1.65V ~ 3.3 V	– 0.3V	-	0.2* IOVcc	2,3
Output high voltage (D0-17 pins, FMARK)	V_{OH}	V	IOH = -0.1mA	0.8 * IOVcc	-	-	2
Output low voltage (D0-17 pins, FMARK)	V_{OL}	V	IOVcc = 1.65 ~ 2.4 V I_{OL} = 0.1mA	-	-	0.2* IOVcc	2
I/O leak current	ILi	μA	Vin = 0 ~ IOVcc	-1		1	4
Current consumption during normal operation (Vci-GNDD)+(IOVcc-GND)	IOP(Vci)	mA	Vci=IOVcc=Vci=2.8V, Ta=25C, Fosc=6MHZ(320 Line)GRAM data	-	3	-	

5.2 Timing Specification

5.2.1 4-LINE SPI Interface Timing Characteristics



Signal	Symbol	Parameter	min	max	Unit	Description
DCX	t_{ast}	Address setup time	0	-	ns	
	t_{hat}	Address hold time (Write/Read)	10	-	ns	
CSX	t_{chw}	CSX "H" pulse width	0	-	ns	
	t_{cs}	Chip Select setup time (Write)	15	-	ns	
	t_{rcs}	Chip Select setup time (Read ID)	45	-	ns	
	t_{rcsfm}	Chip Select setup time (Read FM)	355	-	ns	
	t_{csf}	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	t_{wc}	Write cycle	66		ns	
	t_{wrh}	Write Control pulse H duration	33	-	ns	
	t_{wrl}	Write Control pulse L duration	33	-	ns	
RDX (ID)	t_{rc}	Read cycle (ID)	160	-	ns	When read ID data
	t_{rdh}	Read Control pulse H duration	90	-	ns	
	t_{rdl}	Read Control pulse L duration	45	-	ns	
RDX (FM)	t_{rcfm}	Read Cycle (FM)	450	-	ns	When read from the frame memory
	t_{rdhfm}	Read Control H duration (FM)	90	-	ns	
	t_{rdlfm}	Read Control L duration (FM)	355	-	ns	
DB[17:0], DB[15:0], DB[8:0], DB[7:0]	t_{dst}	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	t_{dht}	Write data hold time	10	-	ns	
	t_{rat}	Read access time	-	40	ns	
	t_{ratfm}	Read access time	-	340	ns	
	t_{rod}	Read output disable time	20	80	ns	

5.2.2 Reset Input Timing

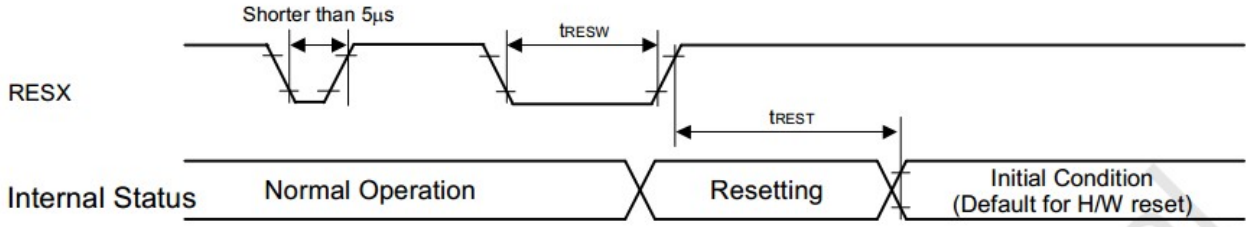


Table 7.3.2.1 Reset input timing VSS=0V, VDDIO=1.6V to 3.6V, VCI=2.5V to 5.5V,Ta = -30 to 70°C

Symbol	Parameter	Related Pins	MIN	TYP	MAX	Note	Unit
t_{RESW}	*1) Reset low pulse width	RESX	10	-	-	-	µs
t_{REST}	*2) Reset complete time	-	-	-	5	When reset applied during Sleep in mode	ms
		-		-	120	When reset applied during Sleep out mode	ms

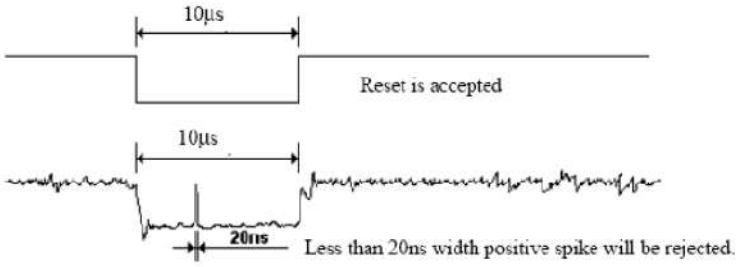
Figure 5 Reset Input Timing

Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
tRESW	Reset low pulse width(1)	NRESET	10	-	-	-	μs
tREST	Reset complete time(2)	-	5	-		When reset applied during STB OUT mode	ms
		-	120	-		When reset applied during STB mode	ms
tPRES	Reset goes high level after Power on time	NRESET & IOVCC	1	-	-	Reset goes high level after Power on	ms

Note: (1) Spike due to an electrostatic discharge on NRESET line does not cause irregular system reset according to the table below.

NRESET Pulse	Action
Shorter than 5 μs	Reset Rejected
Longer than 10 μs	Reset
Between 5 μs and 10 μs	Reset Start

(2) 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 STB Out –mode. The display remains the blank state in STB –mode) and then return to Default condition for H/W reset.
(3) During Reset Complete Time, VMF value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of NRESET.
(4) Spike Rejection also applies during a valid reset pulse as shown below:



(5) It is necessary to wait 5msec after releasing !RES before sending commands. Also STB Out

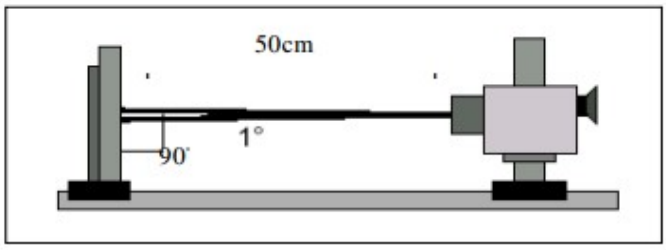
6. Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp	θ=0° Φ=0°	200	230	-	Cd/m^2	1
Uniformity	△Bp		-	80%	-		1,2
Viewing Angle	Φ=90° UP（12:00）	Cr≥10	40	50	-	Deg	3
	Φ=270° Down（6:00）		30	40	-		
	Φ=180° Left（9:00）		40	50	-		
	Φ=0° Right（3:00）		40	50	-		
Contrast Ratio	Cr	θ=0° Φ=0°	200	300		-	4
Response Time	T_r		-	25	50	ms	5
	T_f						

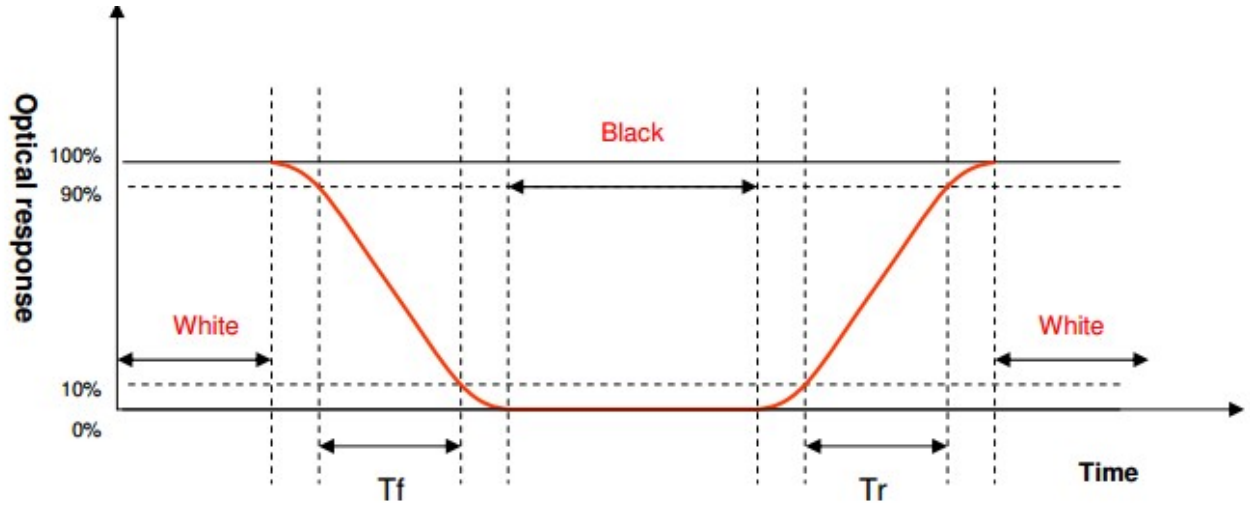
Note 1: Ambient temperature =25℃±2℃.

Note 2: To be measured in the dark room with backlight unit.

Note 3: To be measured at the center area of panel with a viewing cone of 1° by Topcon luminance meter BM-7, after 10 minutes operation (module).



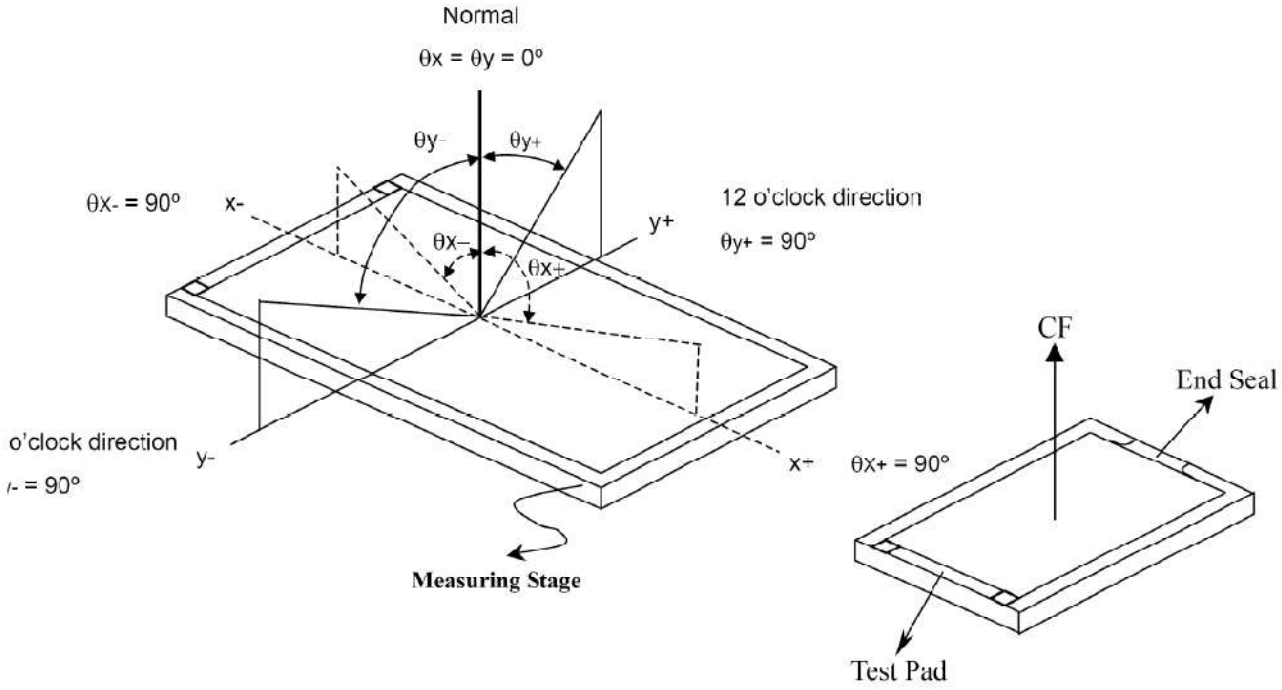
Note 4: Definition of response time:
The output signals of photo detector are measured when the input signals are changed from “black” to “white”(falling time) and from “white” to “black”(rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below:



Note 5. Definition of contrast ratio:
Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Photo detector output when LCD is at “White” state}}{\text{Photo detector output when LCD is at “Black” state}}$$

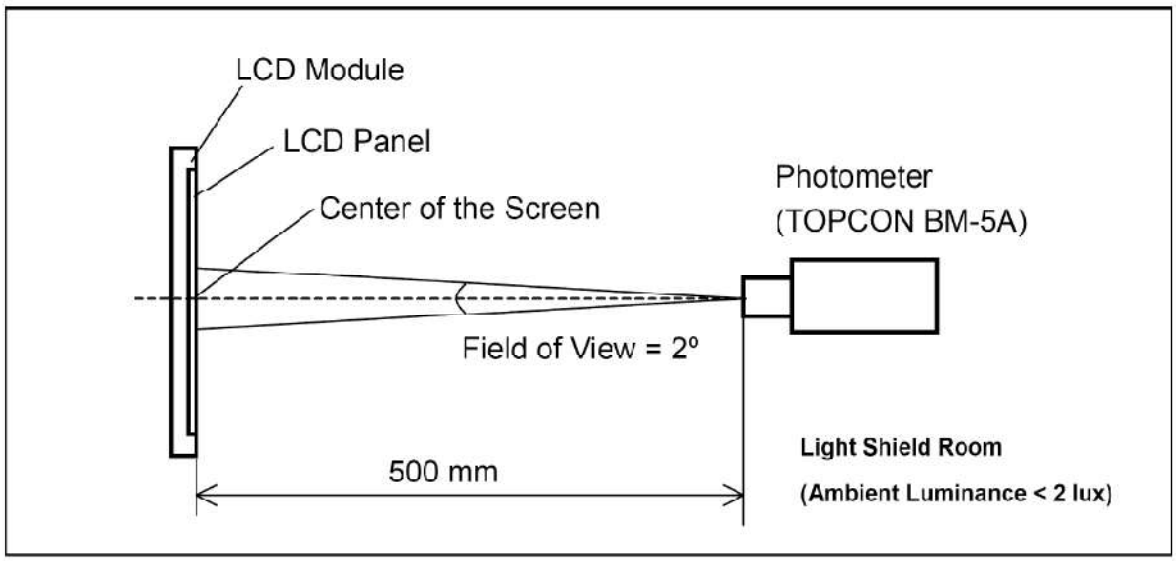
Note 6. Definition of viewing angle:
Refer to the figure as below.



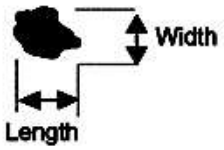
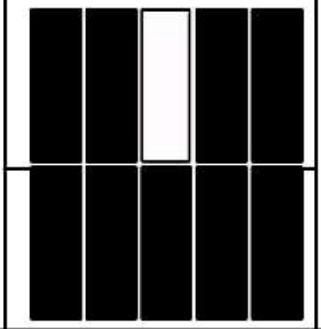
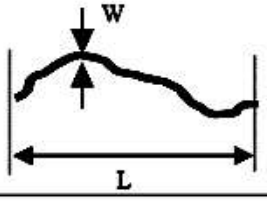
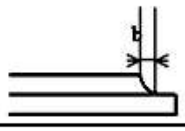
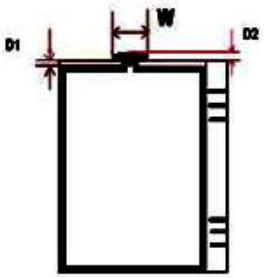
*** The above "Viewing Angle" is the measuring position with Largest Contrast Ratio; not for good image quality. View Direction for good image quality is 6 O'clock. Module maker can increase the "Viewing Angle" by applying Wide View Film.

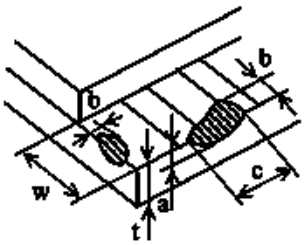
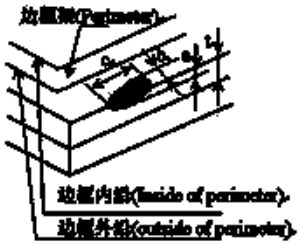
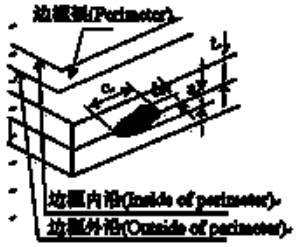
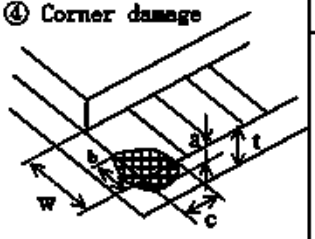
*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



7. TFT panel inspection specification

Failure mode	Illustration	Category(Unit: mm)		Acceptable count	
				Viewing area	non-Viewing area
Black spot White spot	 Φ= (Length+width)/2	A	Φ≦0.10	Not count	Not count
		B	0.10<Φ≦0.15	2, The gap between the two spots should be 5 mm and above.	
		C	0.15<Φ≦0.20	1	
		D	0.20<Φ	0	
Bright spot(Red spot,green spot and blue spot caused by damaged colour filter)		A	Area≦1 sub-pixel	1	N/A
Black line White line		A	W≦0.03	Not count	Not count
		B	0.03<W≦0.05, L≦3.0	2	
		C	0.05<W	Judged by spot spec	
Below are cosmetic inspection specifications					
Excess glass		b≦1.0, this defect shall not affect the outline dimension or assembly process.(Remarks: For COG process, the defect size is decided by the dimension of LCD panel.)			
		This defect shall not affect the outline dimension or assembly process.			
The depth of UV glue entered in LCD cell		a. D1≧0.2，not enter into viewing area b. D2≦0.8, c. W=End mouth width + (2~6 mm)			

<table>
<tr><td rowspan="5">Glass defect(scratch ,damage)</td><td>① LCD ledge damage
  </td><td colspan="2">Category</td></tr>
<tr><td rowspan="3"></td><td>A</td><td>The defect shall not affect the outline dimension or assembly process at non ITO zone.</td></tr>
<tr><td>B</td><td>b≦1/4w, a & c not count (at ITO zone)</td></tr>
<tr><td>C</td><td>Alignment mark on LCD ledge shall not be damaged.</td></tr>
<tr><td>② Outside of perimeter damage
  </td><td colspan="2">b can't reach inside of perimeter.</td></tr>
<tr><td>③ Joint glass damage
  </td><td colspan="2">b can't reach outside of perimeter or ITO layout.</td></tr>
<tr><td>④ Corner damage
  </td><td>A</td><td>a ≦ t, b ≦ 3.0, c ≦ 3.0</td></tr>
<tr><td colspan="2">B. Alignment mark on LCD ledge shall not be damaged.</td></tr>
<tr><td colspan="3">Remark: a stands for thickness of damage, b for width, c for length and t for glass thickness. (Unit: mm)</td></tr>
</table>

8. Remark

HANDLING LCD AND LCD MODULES

一、 Liquid Crystal Display(LCD)

LCD is made up of glass, organic sealant, organic fluid and polymer based polarizers. The following precautions should be taken when handling.

(1) Keep the temperature within range for use and storage. Excessive temperature and humidity could cause polarization degredation, polarizer peel-off or bubble generation. When storage for a long period over 40℃ is required, the relative humidity should be kept below 60%.

(2) Do not contact the exposed polarizers with anything harder than an HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin. Never scrub hard.

(3) Brilliant does not responsible for any polarizer defect after the protective film has been removed from the display.

(4) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.

(5) PETROLEUM BENZIN is recommended to remove adhesives used to attach front/rear polarizers and reflectors, while chemicals like acetone, toluene, ethanol and isopropyl alcohol will cause damage to the polarizer. Avoid oil and fats. Avoid lacquer and epoxies which might contain solvents and hardeners to cause electrode erosion. Some solvents will also soften the epoxy covering the DIL pins and thereby weakening the adhesion of the epoxy on glass. This will cause the exposed electrodes to erode electrochemically when operating in high humidity and condensing environment.

(6) Glass can be easily chipped or cracked from rough handling, especially at corners and edges.

(7) Do not drive LCD with DC voltage.

(8) When soldering DIL pins, avoid excessive heat and keep soldering temperature between 260℃ to 300℃ for no more than 5 seconds. Never use wave or reflow soldering.

二、 Liquid Crystal Display Modules(MDL)

A. Mechanical Considerations

MDL's are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.

(1) Do not tamper in any way with the tabs on the metal frame.

(2) Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.

(3) Do not touch the elastomer connector (conductive rubber), especially when inserting an EL panel.

(4) When mounting a MDL make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.

(5) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed an lose contact, resulting in missing pixels.

(6) If FPCA need to be bent, please refer the suggested bending area on the specification. The stiffener and component area on FPC/FFC/COF must not be bent during or after assembly (Note: for those models with FPC/FFC/COF + stiffener).

(7) Sharp bending should be avoided on FPC to prevent track cracking.

B. Static Electricity

MDL contains CMOS LSI's and the same precaution for such devices should apply, namely:

(1) The operator should be grounded whenever he comes into contact with the module. Never touch any of the conductive parts such as the LSI pads. The copper leads on the PCB and the interface terminals with any part of the human body.

(2) The modules should be kept in antistatic bags or other containers resistant to static for storage.

(3) Only properly grounded soldering irons should be used.

(4) If an electric screwdriver is used it should be well grounded and shielded from commutator sparks.

(5) The normal static prevention measures should be observed for work clothes and working bencher; for the latter conductive(rubber) mat is recommended.

(6) Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

C. Soldering

(1) Solder only to the I/O terminals.

(2) Use only soldering irons with proper grounding and no leakage.

(3) Soldering temperature is 280℃ ± 10℃.

(4) Soldering time: 3 to 4 seconds.

(5) Use eutectic solder with resin flux fill.

(6) If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.

(7) Use proper de-soldering methods (e.g. suction type desoldering irons) to remove lead wires from the I/O terminals when necessary. Do not repeat the soldering/desoldering process more than three times as the pads and plated through holes may be damaged.

D. Label

Identification labels will be stuck on the module without obstructing the viewing area of display.

三、 Operation

(1) The viewing angle can be adjusted by varying the LCD driving voltage Vo.

(2) Driving voltage should be kept within specified range, excess voltage shortens display lift.

(3) Response time increase with decrease in temperature.

(4) Display may turn black or dark Blue at temperatures above its operational range; this is however not destructive and the display will return to normal once the temperature falls back to range.

(5) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured". They will recover once the display is turned off.

(6) Condensation at terminals will cause malfunction and possible electrochemical reaction. Relative humidity of the environment should therefore be kept below 60%.

(7) Display performance may vary out of viewing area. If there is any special requirement on performance out of viewing area, please consult Brilliant.

四、 Storage and Reliability

(1) LCD's should be kept in sealed polyethylene bags while MDL's should use antistatic ones. If properly sealed, there is no need for desiccant.

(2) Store in dark places and do not expose to sunlight or fluorescent light. Keep the temperature between 0℃ and 35℃ and the relative humidity low. Please consult Brilliant for other storage requirements.

(3) Water condensation will affect reliability performance of the display and is not allowed.

(4) Semi-conductor device on the display is sensitive to light and should be protected properly.

(5) Power up/down sequence.

a) Power UP: in general, LCD supply voltage, Vo must be supplied after logic voltage, VDD becomes steady. Please refer to related IC datasheet for details.

b) Power Down: in general, LCD supply voltage, Vo must be removed before logic voltage, VDD turns off. Please refer to related IC datasheet for details.

五、 Safety

If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all times.