



Specification

For

LCD Module

TS8026Y

MODULE:	TS8026Y
CUSTOMER:	

REV	DESCRIPTION	DATE
3	ADD Touch panel characteristics	2009.07.22

TZD	INITIAL	DATE
APREPARED BY		2009.07.22
CHECKED BY		
APPROVED BY		

CUSTOMER	INITIAL	DATE
APPROVED BY		



Revision History

[illegible]

Part. No.	TS8026Y	Rev 3		Page	2/24
-----------	---------	-------	--	------	------



Contents

General Description

1. Optical Characteristics
2. Electrical Characteristics
3. Input Terminal Pin Assignment
4. Operating Principle & Methods
5. Operation Sequence
6. Reliability Test Result
7. Outline dimension
8. Packing
9. Cautions and Handling Precautions
- 10.Touch panel
11. BOM



General Description

* Description

This is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a Transmissive type TFT-LCD Panel, driver circuit ,back-light unit. The resolution of a 2.8" TFT-LCD contains 240 x 320 pixels, and can display up to 262K colors.

* Features

- Low Input Voltage : VCC : 2.8-3.3V
- Display Colors of TFT LCD : 262K colors
- CPU Interface : 8080 parallel 8 bit
- Internal Power Supply Circuit.

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	43.2(H) *57.60(V) (2.8 inch)	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	262K	colors	-
Number of pixels	240(RGB) *320	dots	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.18(H) *0.18(V)	mm	-
Viewing angle	12	o'clock	-
Drive IC	ST7781	-	-
Display mode	Transmissive/ Normally White	-	-
Operating temperature	-20~+70℃	-	-
Storage temperature	-30~+80℃	-	-

● Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	-	50	-	mm	-
	Vertical(V)	-	69.2	-	mm	-
	Depth(D)	-	3.9	-	mm	-
Weight		-	TBD	-	g	-



1. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).

Measuring equipment: LCD-7200, BM-5A, BM-7, PR-650, EZ-Contrast

Optical Characteristics

-1) Specification: (following data was test with Sumitomo AG polarizer and LED B/L (L = 4820 nits)

Ta = 25℃

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remarks
Viewing Angle	Horizontal	$\theta 11, \theta 12$	45	50	--	deg	Note 6-1
	Vertical	$\theta 21$	10	15	--	deg	
		$\theta 22$	30	35	--	deg	
Brightness	L	$\theta = 0^\circ$	250	300	--	cd/m ²	
Contrast Ratio	CR	At optimized Viewing angle	300	350	--		Note 6-2
Response time	Rise	$\theta = 0^\circ$	--	15	20	ms	Note 6-3
	Fall		--	20	30	ms	
Transmission Ratio	T	$\theta = 0^\circ$	6	6.5	--	%	
NTSC		58				%	
Color Coordinate (CIE) (Color Filter vendor provide Color Coordinate data)							
Red	Xr	$\theta = 0^\circ$	0.598	0.628	0.658	---	w/o polarizer
	Yr	$\theta = 0^\circ$	0.298	0.328	0.358	---	
Green	Xg	$\theta = 0^\circ$	0.257	0.287	0.317	---	
	Yg	$\theta = 0^\circ$	0.532	0.562	0.598	---	
Blue	Xb	$\theta = 0^\circ$	0.107	0.137	0.167	---	
	Yb	$\theta = 0^\circ$	0.096	0.126	0.156	---	
White	Xw	$\theta = 0^\circ$	0.276	0.306	0.336	---	
	Yw	$\theta = 0^\circ$	0.302	0.332	0.367	---	

*

Measuring equipment : BM-7

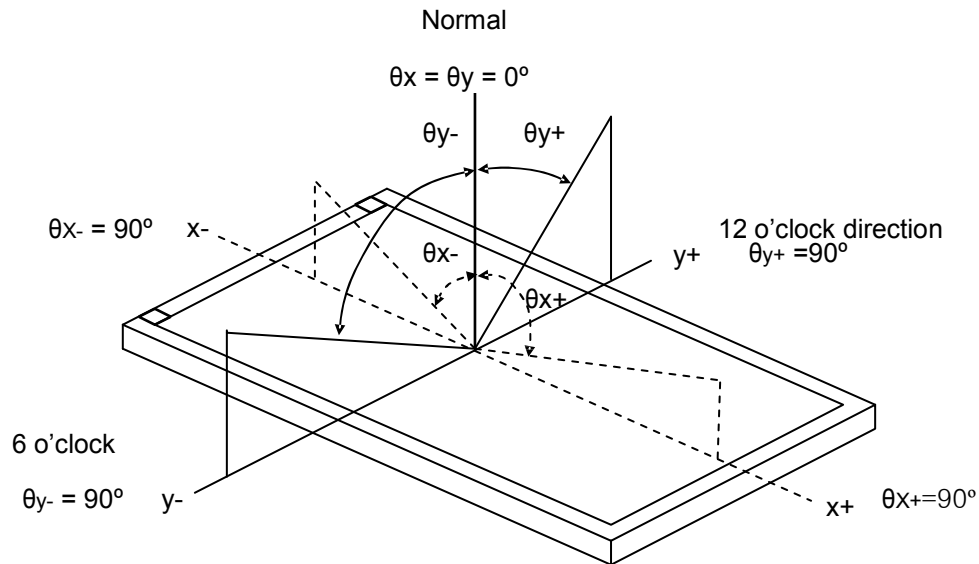
Note (1) If product is exposed to high temperatures for extended time, there is a possibility of the polarizer film damage which could degrade the optical characteristics.

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

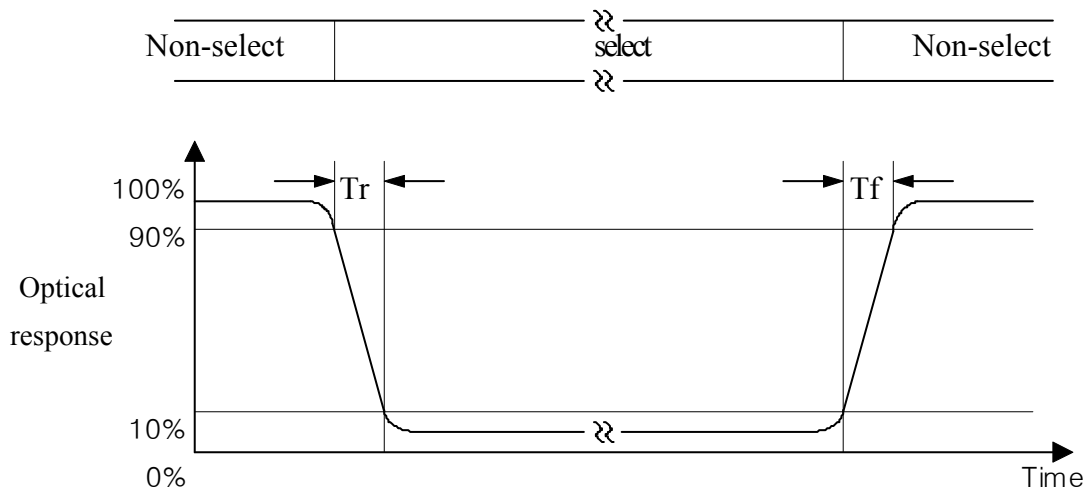
$$CR = \frac{\text{Luminance (brightness) all pixels "White"}}{\text{Luminance (brightness) all pixels "dark"}}$$



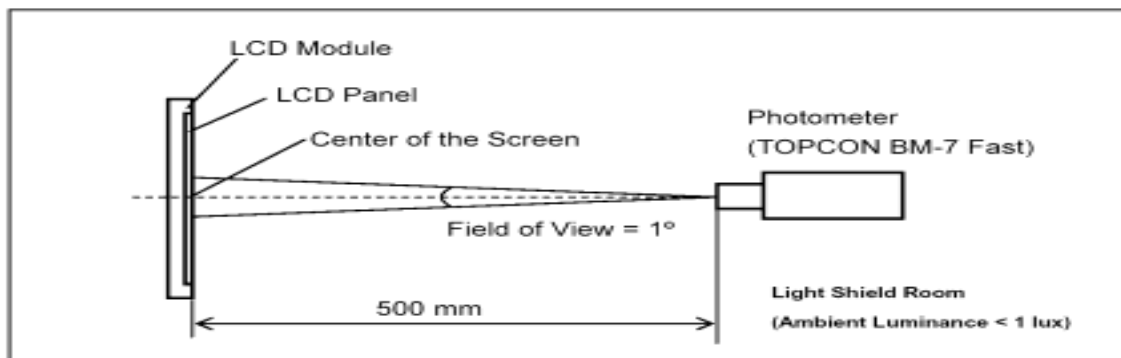
Note (3). Definition of Viewing Angle (θ_x , θ_y):



Note (4) Definition of Response Time (T_R , T_F):



Note (5) Measurement Set-Up: Measure after lighting Backlight for 30 minutes in a windless room.





2. Electrical Characteristics

2.1 ABSOLUTE MAXIMUM RATING(Ta=25 VSS=0V)

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Supply voltage for Logic	V _{CC}	-0.3	2.8	+4.6	V	-
Logic signal input voltage	V _{IN}	-0.3	-	V _{DDI} +0.3	V	-
Operating temperature	T _{OP}	-20	-	+70	°C	1,2
Storage temperature	T _{ST}	-30	-	+80	°C	1,2

Note1: Background color changes slightly depending on ambient temperature.

This phenomenon is reversible. Ta70°C: 75%RH max

Ta>70°C: absolute humidity must be lower than the humidity of 75%RH at 70°C

Note2: Ta at -30°C will be <48hrs, at 80°C will be <120hrs

2.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Supply voltage for Logic	V _{CC}	2.7	2.8	3.3	V	-
Current consumption	I _{CC} +I _{CI}	-	8		mA	-
Level input voltage	V _{IH}	0.7V _{DDI}	-	V _{DDI}	V	-
	V _{IL}	V _{SS}	-	0.3V _{DDI}	V	-
Level output voltage	V _{OH}	V _{SS}	-	V _{DDI}	V	-
	V _{OL}	V _{SS}	-	0.2V _{DDI}	V	-

2.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 4chips White LED in parallel

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I _B	-	60	-	mA	
Forward Voltage	V _F	-	3.2	-	V	-
Luminance	L _V	3000	3300	-	cd/m ²	I _B =60mA
Uniformity	A _{Vg}	80	-	-	%	-



3. Input terminal Pin Assignment

3.1 Input signal & Power

Pin NO.	Symbol	Function
1	NC	
2	RESET	This signal will reset the device and it must be applied to properly initialize the chip.
3	Y-	Touch panel coordinate(Down)
4	Y+	Touch panel coordinate(Up)
5	X+	Touch panel coordinate(Right)
6	X-	Touch panel coordinate(Left)
7	CS	Chip selection pin ("Low" is enable) signal
8	RS	Display data/command selection pin in MCU interface. RS='1': display data or parameter. RS='0': command data.
9	WR	Write enable in 8080 MCU parallel interface.
10	RD	Read enable in 8080 MCU parallel interface.
11	DB17	MCU parallel interface data bus. D17: MSB D10: LSB
12	DB16	
13	DB15	
14	DB14	
15	DB13	
16	DB12	
17	DB11	
18	DB10	
19	VSS	Power Ground
20	A	Backlight Power supply
21	K1	Backlight Ground
22	K2	Backlight Ground
23	K3	Backlight Ground
24	K4	Backlight Ground
25	VCC	Power supply



3.2 Input Signal, Basic Display Colors and Gray scale of Each Colors

COLOR	Display																			GRAY
		RED						GREEN						BLUE						SCALE LEVEL
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	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	-
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-
	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	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R3~R60
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	↓ LIGHT	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R61
		0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R62
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R63
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	G1
	↑	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	G2
		⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	G3~G60
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
	↓ LIGHT	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	G61
		0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	G62
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	G63
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B2
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	B3~B60	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	B61
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B62
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B63

Note) Defintion of Gray :

Rn: Red Gray, Gn : Green Gray, Bn: Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage , 1 = High level votage



4. Operating Principle & Methods

Please refer to ST7781 datasheet for more details.

80-System Interface Timing Characteristics

Normal Write Mode (IOVCC = 1.65~3.3V, VCC=2.4~3.3V)

Item	Symbol	Unit	Min.	Typ.	Max.	Test Condition
Bus cycle time	Write	t_{CYCW}	ns	100	-	-
	Read	t_{CYCR}	ns	300	-	-
Write low-level pulse width	PW_{LW}	ns	50	-	-	-
Write high-level pulse width	PW_{HW}	ns	50	-	-	-
Read low-level pulse width	PW_{LR}	ns	150	-	-	-
Read high-level pulse width	PW_{HR}	ns	150	-	-	-
Write / Read rise / fall time	t_{WRr}/t_{WRf}	ns	-	-	25	-
Setup time	Write (RS to nCS, E/nWR)	t_{AS}	ns	10	-	-
	Read (RS to nCS, RW/nRD)			5	-	-
Address hold time	t_{AH}	ns	5	-	-	-
Write data set up time	t_{DSW}	ns	10	-	-	-
Write data hold time	t_H	ns	15	-	-	-
Read data delay time	t_{DDR}	ns	-	-	100	-
Read data hold time	t_{DHR}	ns	5	-	-	-

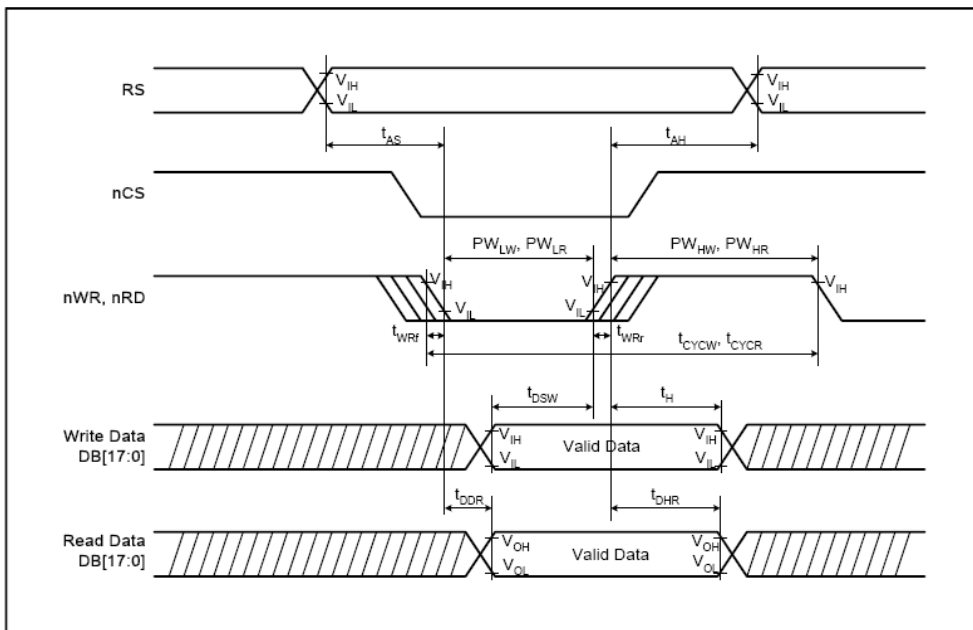


Figure 4.1 80 SYSTEM BUS TIMING



4.2 RESET TIMING

Reset Timing Characteristics (VCC = 1.8 ~ 3.3 V, IOVCC = 1.65 ~ 3.3 V)

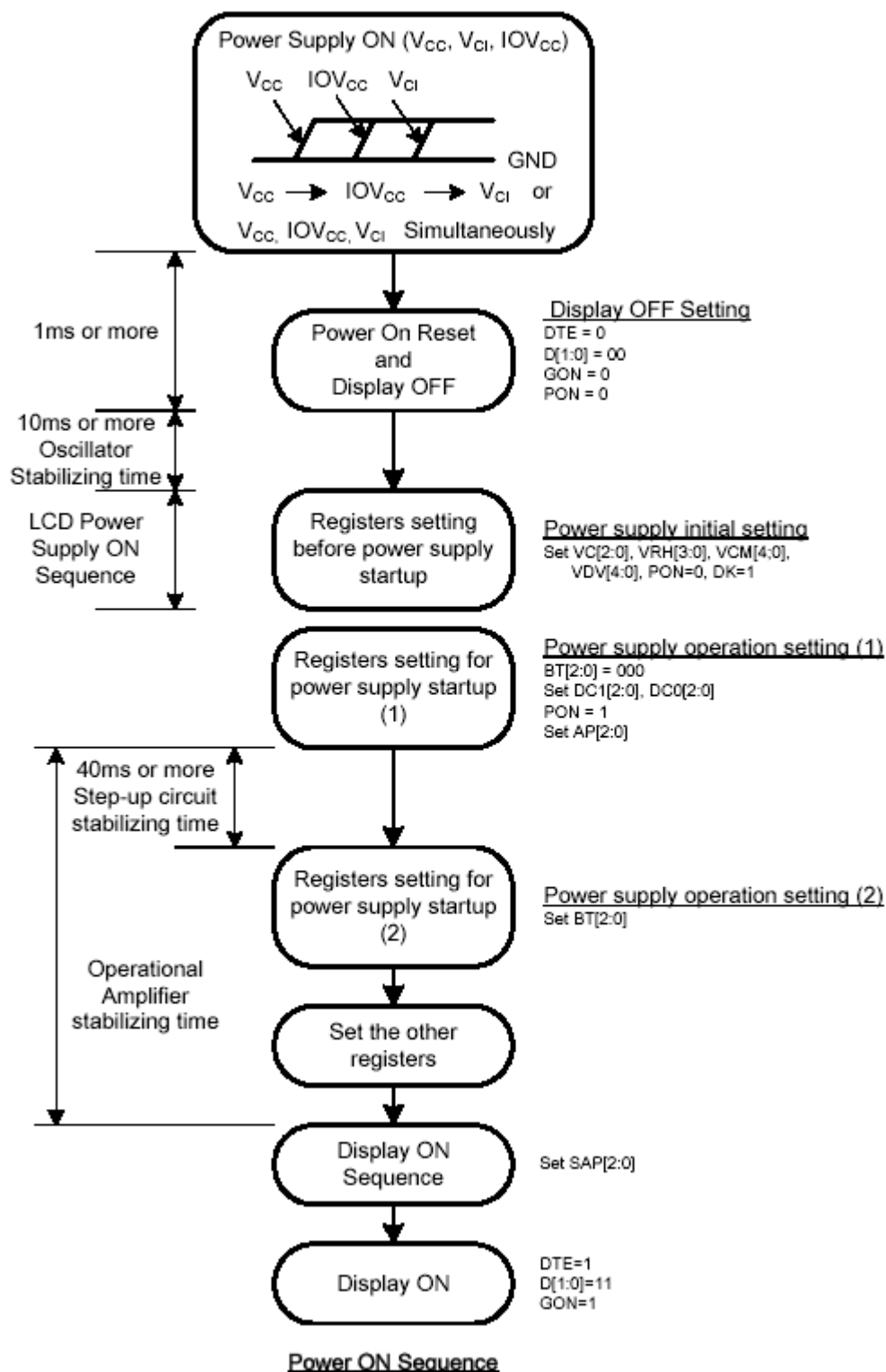
Item	Symbol	Unit	Min.	Typ.	Max.
Reset low-level width	t_{RES}	ms	1	-	-
Reset rise time	t_{rRES}	μ s	-	-	10





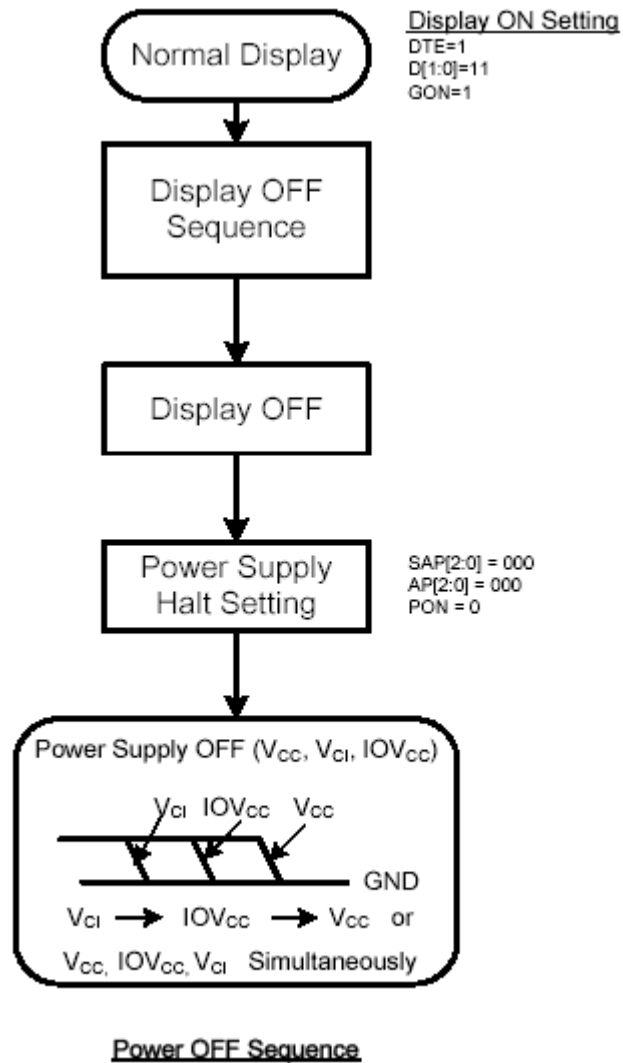
5. Operation Sequence:

5.1 Power On Sequence



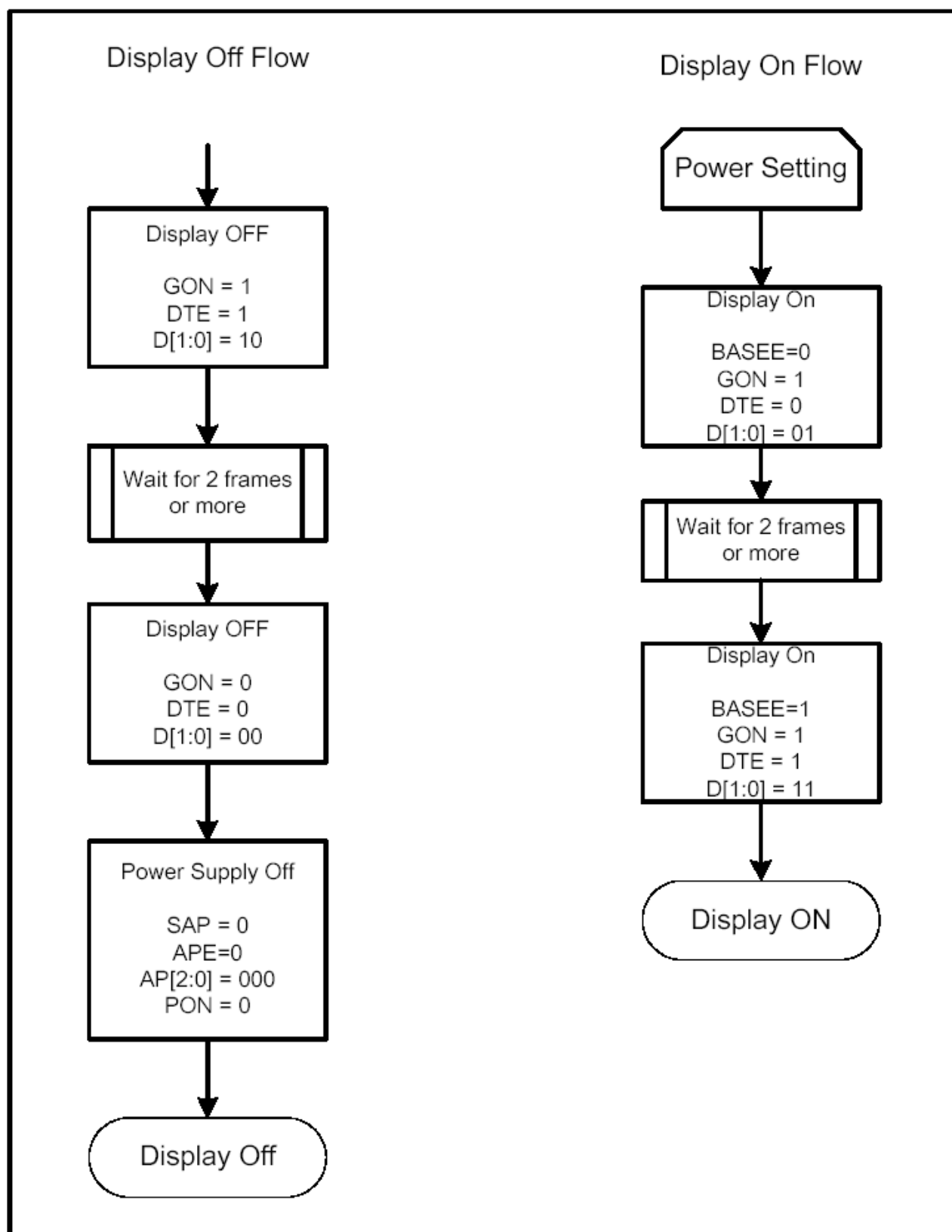


5.2 Power Off Sequence





5.3 Display On/Off Sequence





6. Reliability Test Result

6.1 Condition

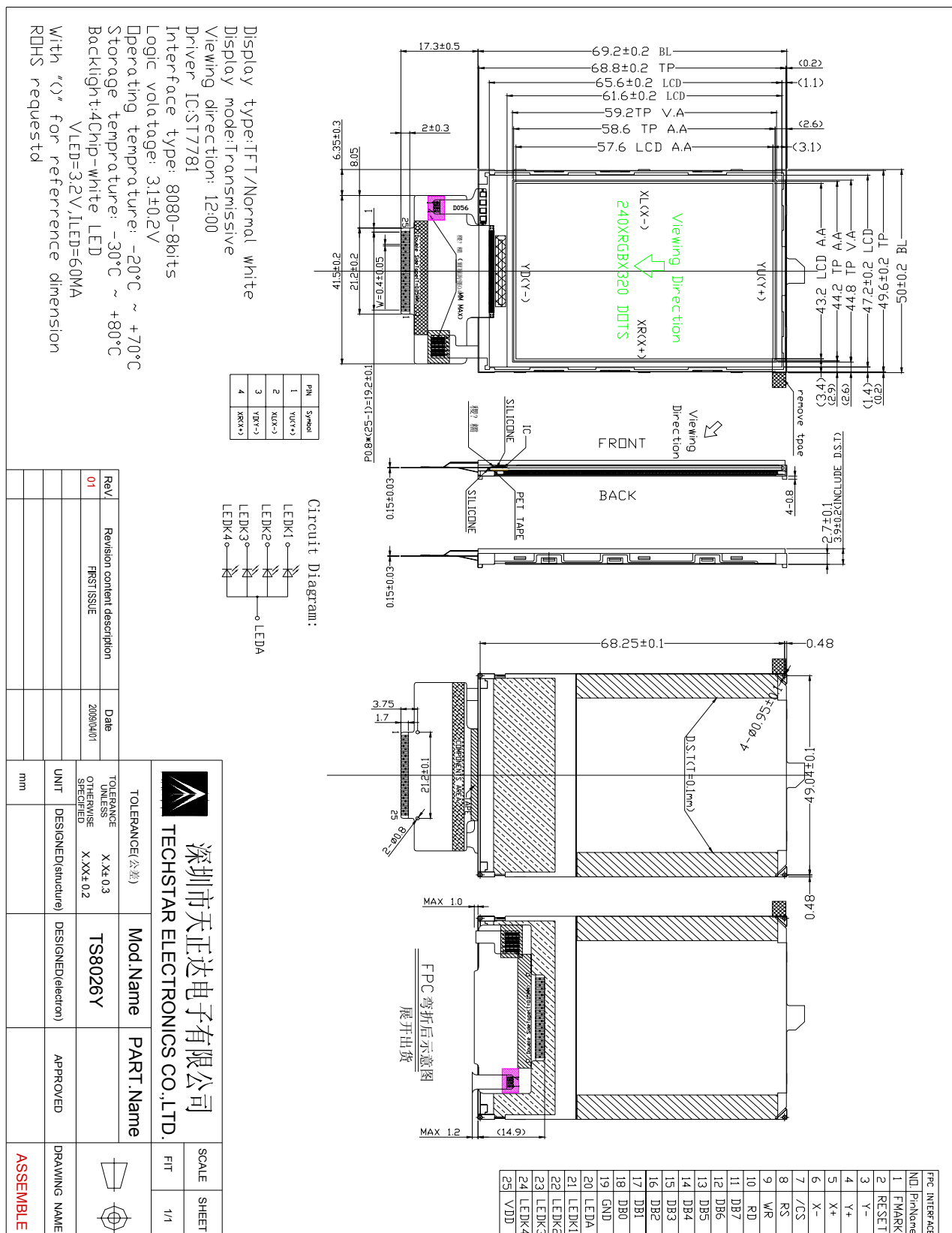
Item	Condition	Sample Size	Test Result	Note
Low Temperature Operating Life test	-20℃, 96HR	5ea	TBD	-
Thermal Humidity Operating Life test	60℃, 90%RH, 96HR	10ea	TBD	-
Temperature Cycle ON/OFF test	-20℃ ↔ 70℃, ON/OFF, 20CYC	5ea	TBD	(1)
High Temperature Storage test	80℃, 96HR	5ea	TBD	-
Low Temperature Storage test	- 30℃, 96HR	5ea	TBD	-
Thermal Shock test	(-20℃ ⇔ 70℃) ^{8CYC}	5ea	TBD	(2)
ESD CDM	Contact	+/-4kV, 5 times	5ea	TBD
	Air	+/-8kV, 5 times	5ea	TBD
Box Vibration Test	Acceleration:1.5G, Vibration width : 3 mm Sweep range : 5-55 Hz Vibration direction : X, Y, Z axis 120 cyc	1box	TBD	
Box Drop Test	1 Corner 3 Edges 6 faces, 66cm(MEDIUM BOX)	1box	TBD	-

Note (1) ON Time over 10 seconds, OFF Time under 10 seconds

(2)

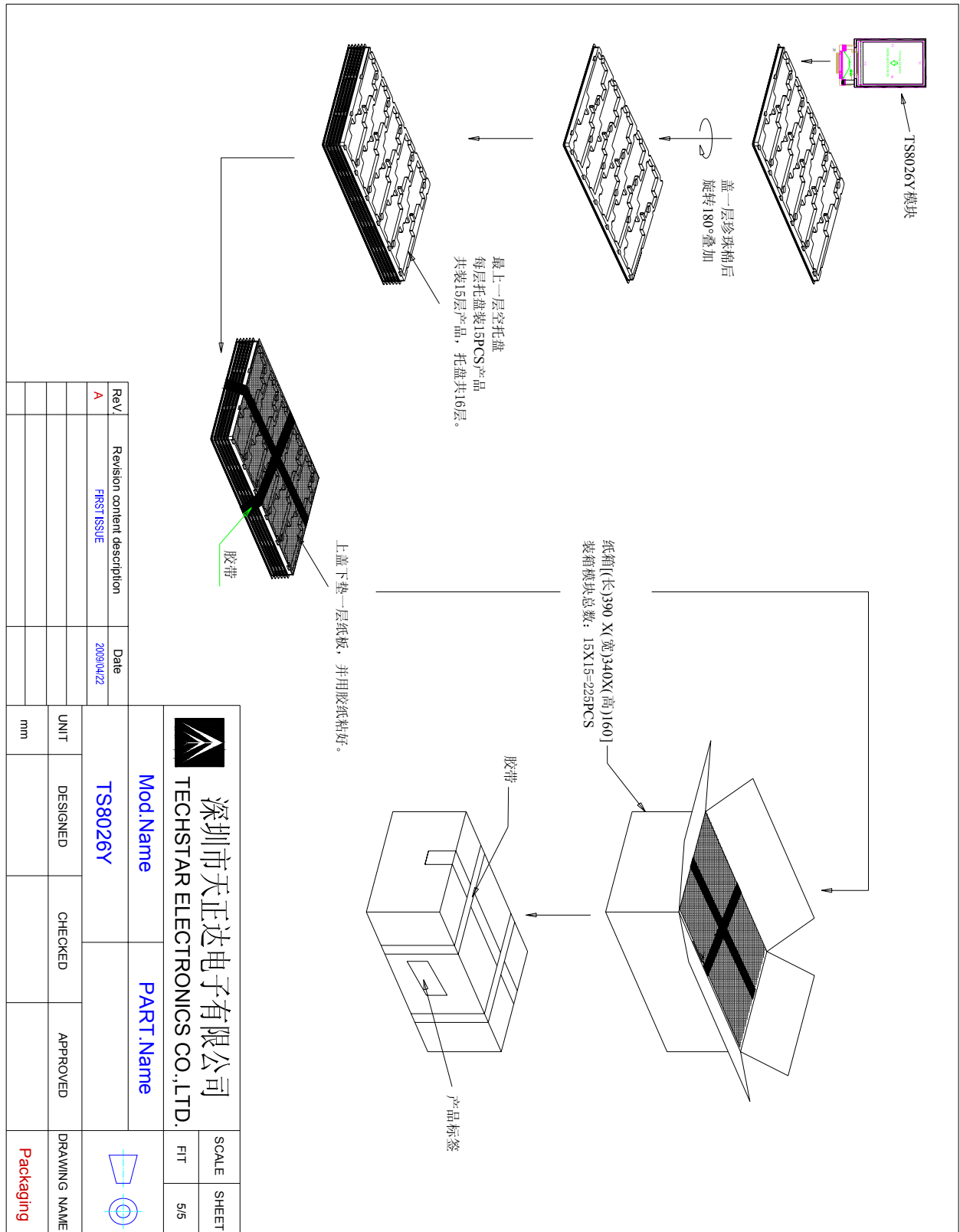
STEP Order	Temperature	Humidity	Time	Test	Note
1	+ 25 ℃	65 %	3 Hr	Function Test	① Temperature : within 3 ℃ below 1 ℃/min
2	- 20 ℃	0 %	12 Hr	Auto Test	
3	+ 25℃	65 %	1 Hr	Function Test	
4	+ 70 ℃	90 %	12 Hr	Auto Test	
5	+ 25 ℃	65 %	1 Hr	Function Test	
6	- 20 ℃	0 %	12 Hr	Auto Test	
7	+ 70 ℃	95 %	12 Hr	Auto Test	
8	+ 25 ℃	65 %	3 Hr	Final Test	

7. Outline dimension





8. Packing





9. Cautions and Handling Precautions

9.1 Handling and Operating the Module

(1) When the module is assembled, it should be attached to the system firmly.

Do not warp or twist the module during assembly work.

(2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.

(3) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface.

(4) Do not allow drops of water or chemicals to remain on the display surface.

If you have the droplets for a long time, staining and discoloration may occur.

(5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.

Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.

(8) Protect the module from static, it may cause damage to the CMOS ICs.

(9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(10) Do not disassemble the module.

(11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(12) Pins of I/F connector shall not be touched directly with bare hands.

(13) Do not connect, disconnect the module in the "Power ON" condition.

(14) Power supply should always be turned on/off by the item 5.1 Power On Sequence & 5.2 Power Off Sequence



9.2 Storage and Transportation.

(1) Do not leave the panel in high temperature, and high humidity for a long time.

It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%

(2) Do not store the TFT-LCD module in direct sunlight.

(3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.

(4) It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module. In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.

(5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.



10. Touch panel

10.1 使用环境

工作温度: $-10^{\circ}\text{C} \sim +60^{\circ}\text{C}$

存储温度: $-20^{\circ}\text{C} \sim +70^{\circ}\text{C}$

存储湿度: $5\% \sim 90\% \text{ RH}$

10.2 可靠性实验

A. 高温高湿: $+60^{\circ}\text{C}$ & $90\% \text{ RH}$, 120H

从环测机取出, 在室温下放置24小时后进行测试, 必须满足下列条件:

回路电阻: X: $200\ \Omega \sim 900\ \Omega$, 与测试前偏差15%以内。

Y: $200\ \Omega \sim 900\ \Omega$, 与测试前偏差15%以内。

绝缘阻抗: $>20\ \text{M}\ \Omega$ @25V(DC)

线性: $< 1.5\%$

B. 高低温冲击: -20°C , 2.5H, 60°C , 2.5h, 28个循环。

从环测机取出, 在室温下放置24小时后进行测试, 必须满足下列条件:

回路电阻: X: $200\ \Omega \sim 900\ \Omega$, 与测试前偏差15%以内。

Y: $200\ \Omega \sim 900\ \Omega$, 与测试前偏差15%以内。

绝缘阻抗: $>20\ \text{M}\ \Omega$ @25V(DC)

线性: $< 1.5\%$

C. 高温高湿循环: 45°C & $50\% \text{ RH}$, 2.5H 60°C & $90\% \text{ RH}$, 2.5H, 12个循环



从环测机取出，在室温下放置24小时后进行测试，必须满足下列条件：

回路电阻：X: $200\ \Omega \sim 900\ \Omega$ ，与测试前偏差15%以内。

Y: $200\ \Omega \sim 900\ \Omega$ ，与测试前偏差15%以内。

绝缘阻抗: $>20\ M\ \Omega @25V(DC)$

线性: $< 1.5\%$

10.3 笔划测试

≥ 10 万次

笔头大小: 2mm

笔头压力: 250g

笔头材质: 树脂

笔画速度: 60mm/sec

在同一位置划线10 万次，需满足下列条件：

回路电阻：X: $200\ \Omega \sim 900\ \Omega$

Y: $200\ \Omega \sim 900\ \Omega$

绝缘阻抗: $>20\ M\ \Omega @25V(DC)$

线性: $< 1.5\%$



10.4 点击测试

≥ 100 万次

笔头大小: 2mm

笔头压力: 250g

笔头材质: 硅胶

笔击速度: 120 tims/sec

在同一位置点击100 万次, 需满足下列条件:

回路电阻: X: $200\ \Omega \sim 900\ \Omega$

Y: $200\ \Omega \sim 900\ \Omega$

绝缘阻抗: $>20\ M\ \Omega$ @25V(DC)

线性: $< 1.5\%$

10.5 检验项目 (W: 宽, L: 长, D: 直径 T: 厚度)

外观检查

测试距离: 350mm;

环境亮度: $>200\text{Lux}$

签样对比: 客户样品作为对比参照 (只限客户有特殊要求时的对比使用)。



检查标准

检 查 标 准				
点状		线状 / 刮花		
大小	允许数量	宽	长	允许数量
D≤0.15mm	可接受	W < 0.03mm	/	数量不计,可接受
0.15mm≤D≤0.2mm	最多允许有 3 个,且间距必须大于 5mm;	0.03≤W≤0.06 mm	L≤8.0mm	两线最小距离大于 15mm 可接受,
0.2<D	不允许	W > 0.06mm	/	不接受
玻璃缺陷				
大小（角破损）	允许数量	大小（边破损）		允许数量
触摸区之外 T ≤ ITO 玻璃厚度	可接受	触摸区之外 T ≤ITO 玻璃厚度		
不影响使用电性 L ≤ 4 mm W ≤ 3 mm T ≤ITO 玻璃厚度	可接受	不影响使用电性 W ≤ 2 mm T ≤ITO 玻璃厚度		可接受
L > 4mm	不允许	W > 2mm T > ITO 玻璃厚度		不允许
W > 3mm				
T > ITO 玻璃厚度				
破裂、影响电性	不允许	破裂、影响电性		不允许
备注： 彩虹纹面积小于整片产品三分之一 可以接受；面积大于等于整片产品三分之一 不可以接受。				

**11. BOM**

物料编码	物料分类	物料名称	规格
M8700052	胶纸类	黄色高温绝胶纸	19mm*5mm
M8700073	胶纸类	黑色遮光胶纸	20MM*2.0MM, T=0.1MM
M8700017	胶纸类	易拉胶纸	22*10mm, 3M
M8700075	胶纸类	黄色高温胶纸	5.0MM*3.0MM*0.05MM
M8B00010	触摸屏	触摸屏	49.6MM*68.8MM*1.1MM, D28065G, 东之晖
PL500265	背光	背光	HCT003-280-41A 白光侧背光, 4 颗灯并联
859110A	半成品	FOG	LCD 贴好片压好 IC, FPC 已焊好元器件
759110A	半成品	COF	TS8003I 的 COF (FPC 焊好元器件)
STC97310	胶纸类	ACF	CP9731SB, W1.0mm
FKJ25001	Pin 类连接器	FPC	33.2mm*36.9mm*厚 0.13mm 双面板
C105YHK0	电容	电容	1UF 25V ±10% 0603 贴片电容, X7R
C105YFK0	电容	电容	1UF 10V ±10% 0402 贴片电容, X7R
DC000002	二极管元件	二极管	RB521S-30 二极管, 封装: SOD-523
659110A	半成品	COG	LCD 贴好片压好 IC
FAF9187L	辅助物料	RTV 胶 (SE9187L)	330ML/支 黑色, 道康宁
IIG77810	IC	ST7781	240(RGB)*320 DOTS 262K-COLOR TFT IC
STC69203	胶纸类	ACF	CP6920F, W1.5mm
559110A	半成品	LCDA	2.8TFT, 白玻璃, 视角:12:00, 贴好偏光片
L559110	LCD	LCD	CPT2.8TFT(CLAF028GE01AA), 白玻璃, 视角:12:00
M870012	偏光片	偏光片	TM-P-1536 长 65.6mm*宽 47.2mm*厚 0.22mm 上下光片

备注：以上物料均符合ROHS要求