PRODUCT TFT-LCD Module
产品名称： **TFT 液晶显示模块**
MODELNO
模块型号：**WA54BC045C-12S**
SUPPLIER WOLCD
供应商： 沃乐康科技
PROJECT
适用项目：
DAT
日期： **2023.5.22**

SPECIFICATION FOR

TFT LCD MODULE

TFT 液晶模块规格书

Version 版本号：V0.0

This module uses ROHS material

WOLCD(沃乐康科技)		Customer(客户)
PREPARED BY 制定		□OK □NG，Problem survey:
CHECKED BY 审核		
Quality Department 品质		
Approved By 批准		Approved By:___

1.If there is no special request from customer, WOLCD Will not reserve the tooling of the product under the following conditions:

1.1 There is no response from customer in Three months after WOLCD Submit the samples;

1.2 There is no order in one year after the latest mass production.

2. All correlated data (include WOLCD record) will be reserved one year more after tooling was discarded.

3. If there is no special request from customer, The product of WOLCD Will repair only one year

RECORDS OF REVISION 修改记录

Date 日期	Sheet 页码	Revise No. 版本	SUMMARY 摘要	REMARK 备注
2023/5/22	ALL 所有新	A0	FIRST ISSUE 初始版本	

Contents 目录

1. Introduction 概述介绍

The **WA54BC045C-12S** model is a Color TFT LCD supplied by WOLCD Technology co.,ltd This Module has a **1.54** inch diagonally measured active display area with **240(RGB)×240** resolution. Each pixel is divided into Red, Green and Blue sub-pixels and dots which are arranged in vertical stripes.
LCD color is determined with 1600,000 colors signal for each pixel.

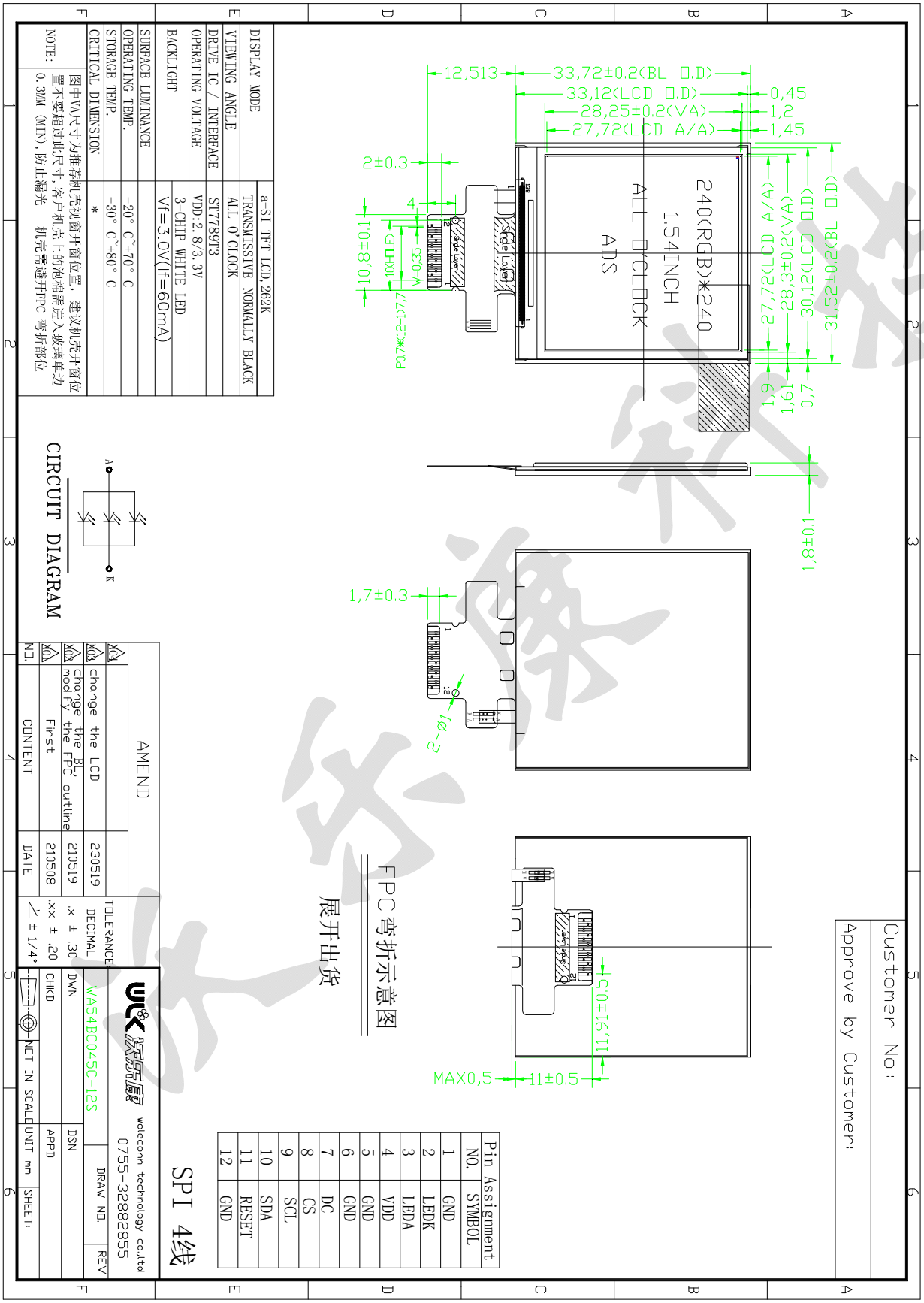
The **WA54BC045C-12S** has been designed to apply the interface method that enables low power, high speed, and high contrast.

The **WA54BC045C-12S** is intended to support applications where thin thickness, wide viewing angle and low power are critical factors and graphic displays are important.

2. General specification 通用规格

ITEM 项目	Standard value 标准值	UNIT 单位
LCD Type 液晶显示类型	TFT NegativeTransmissive Normally black	---
Driver element 驱动元素	a-Si TFT Active matrix	
Number of Dots 点阵数	240*(RGB)*240	Dots
Pixel Arrangement 像素排列	RGB Vertical stripe	
Dot Pitch (W*H)点距	0.1155*0.1155	mm
Active Area 显示区域	27.72(H) × 27.72(V)	mm
Glass Area (W*H)液晶玻璃尺寸	30.32(H)× 33.72 (V)	mm
Viewing Direction 视角方向	ADS ALL O'clock	
LCM Control IC 液晶模块 IC	ST7789T3	
LCM Size(W*H*T)液晶模块尺寸	31.52(W)*33.72(H)*2.05(T)	mm
Approx.Weight 重量	TBD	g
Back Light 背光源	3 chipWhite LED in parallel	
Interface ModeLCM 接口模式	SPI4W	
Touch Panel IC& Interface 触摸屏 IC 和接口类型	-	
Cover lens&sensor Features 盖板功能片特点	-	
Touch Display Assembly Size 触控显示总成尺寸	-	
Fitting method 贴合方式	-	

3. Mechanical drawing 外形机构图



DISPLAY MODE	a-SI TFT LCD, 262K
VIEWING ANGLE	TRANSMISSIVE NORMALLY BLACK
DRIVE IC / INTERFACE	ALL O'CLOCK
OPERATING VOLTAGE	ST7789T3
BACKLIGHT	VDD:2.8/3.3V
	3-CHIP WHITE LED
	Vf=3.0V(If=60mA)
SURFACE LUMINANCE	
OPERATING TEMP.	-20° C~+70° C
STORAGE TEMP.	-30° C~+80° C
CRITICAL DIMENSION	*

NOTE: 图中VA尺寸为推荐机壳视窗开窗位置，建议机壳开窗位置不要超过此尺寸，客户机壳上的泡棉需进入玻璃单边0.3MM (MIN)，防止漏光　机壳需避开FPC 弯折部位

Pin Assignment	
NO.	SYMBOL
1	GND
2	LEDK
3	LEDA
4	VDD
5	GND
6	GND
7	DC
8	CS
9	SCL
10	SDA
11	RESET
12	GND

NO.	CONTENT	DATE
1	First	210508
2	change the BL FPC outline	210519
3	change the LCD modify	230519

AMEND

TOLERANCE
DECIMAL
.x ± .30
.xx ± .20
∠ ± 1/4°

DWN DSN
CHKD APPD
NOT IN SCALE
UNIT mm
SHEET:

woleconn technology co.,ltd
0755-32882855
DRAW NO. WA54BC045C-12S
REV

4. ABSOLUTE MAXIMUM RATINGS 极限参数

Parameter	Symbol	Min	Max	Unit
Supply voltage for I/O logic	IOVCC	-0.3	4.6	V
Analog Voltage	V_{CI}	-0.3	4.6	V
Supply current(One LED)	I_{LED}		20	mA
Operating temperature	T_{OP}	-10	+50	°C
Storage temperature	T_{ST}	-20	+60	°C

5.ELECTRICAL CHARACTERISTICS 电气参数

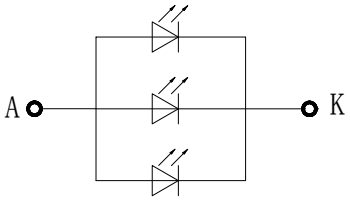
Properties		Sym.	Min	Typ.	Max	Unit	Note
Power for Circuit Driving		VCI	2.5	2.8	3.6	V	Note
Interface Voltage		IOVcc	1.65	1.8	3.3	V	Note
Power for Circuit Logic		Vt	2.6	2.8	3.0	V	Note
BLU Driving Logic		Vbat	2.9	3.0	3.3	V	
Logic Input Voltage	Low Voltage	VIL	VSS	-	0.2Iovcc	V	
	High Voltage	VIH	0.8xIovcc	-	IOVCC	V	
Logic Output Voltage	Low Voltage	VOL	0	-	0.2Vcc	V	
	High Voltage	VOH	0.8Iovcc	-	IOVCC	V	
Power Consumption	White	P_w	T.B.D	T.B.D	T.B.D	mW	
	Black	P_b	T.B.D	T.B.D	T.B.D	mW	
	Vertical Stripe	P_v	T.B.D	T.B.D	T.B.D	mW	

Note

The recommended operating conditions refer to a range in which operation of this product is guaranteed. Should this range is exceeded, the operation cannot be guaranteed even if the values may be without the absolute maximum ratings.

Accordingly, please make sure that the module is used within this range. And these current values are measured under the condition that all devices are stopped, each component is stable and logic signal is input.

6.Backlight Charasterics 背光源参数

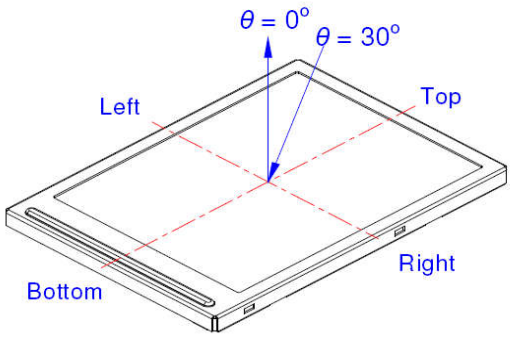


CIRCUIT DIAGRAM

Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	Vf	2.9	3.0	3.3	V	If=20 mA	-
Supply Current	If	-	20	-	mA	-	单 LED-
Reverse Voltage	Vr	-	-	5	V	10uA	
Power dissipation	Pd	-	140	-	mW	-	
Luminous Intensity for LCM		-	250	-	Cd/m^2	If=15mA	
Uniformity for LCM	-	80	-	-	%	If=15 mA	
Life Time	-	50000	-	-	Hr	If=15 mA	-
Backlight Color	White						

7. OPTICAL CHARACTERISTICS 光学特性

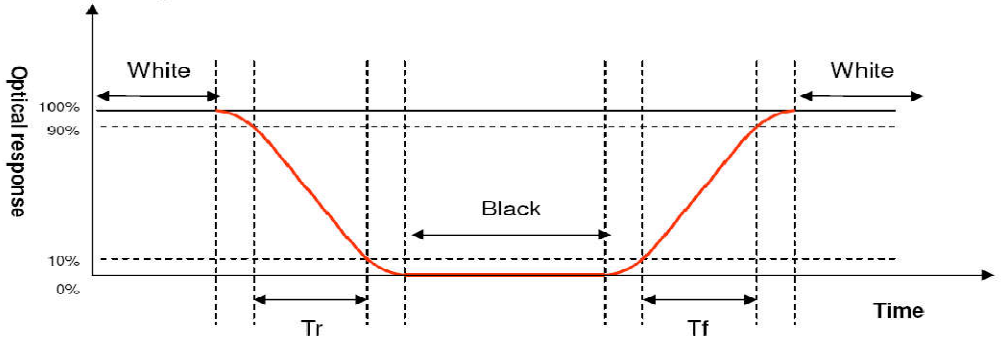
Spec	Parameter	Sym.	Values			Unit	Note
			Min.	Typ.	Max.		
With Back light LED ON	*1)Contrast Ratio	C/R	(700)	（900）			Note
	*1)Threshold Voltage	Vsat				V	FIG.2
		Vth				V	
	*2)Transmittance	T%	(4.6)	（5.4）		%	FIG.1
	*1)Response Time	Tr+ Tf		30	35	Mses	FIG.4
	*1)Viewing Angle	θl	75	80	-	Degree	FIG.5
		θr	75	80	-		
		θu	75	80	-		
		θd	75	80	-		
	*3)CIE Color Coordinate	Wx		0.320			
		Wy		0.343			
		Rx	0.601	0.631	0.661		
		Ry	0.300	0.330	0.660		
		Gx	0.252	0.282	0.312		
		Gy	0.514	0.544	0.574		
		Bx	0.108	0.138	0.168		
		By	0.125	0.155	0.185		
Color Gamut		S(%)	45	50	-	%	FIG.3



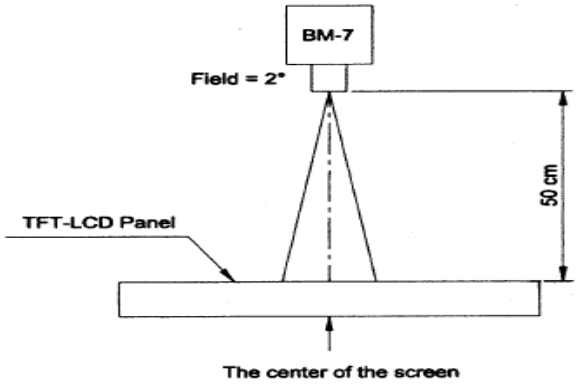
Note 2: Definition of contrast ratio CR:

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

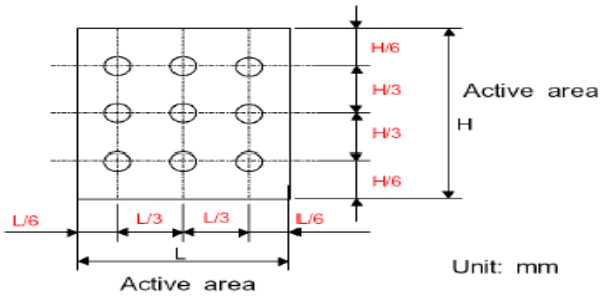
Note 3: Definition of response time (T_R,T_F)



The brightness test equipment setup
20mA Field=2° (As measuring "black" image, field=2° is the best testing condition)



Note 4 :



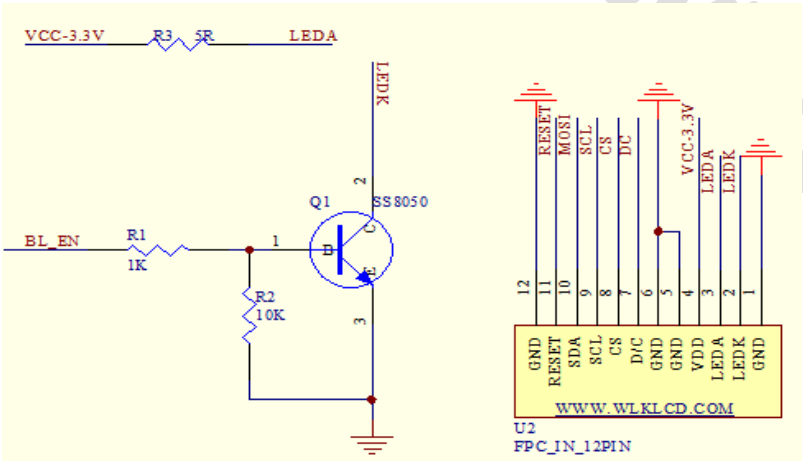
8. Pin Assignment 接口引脚定义

8.1 LCM Interface Pin Function 液晶模块引脚接口功能

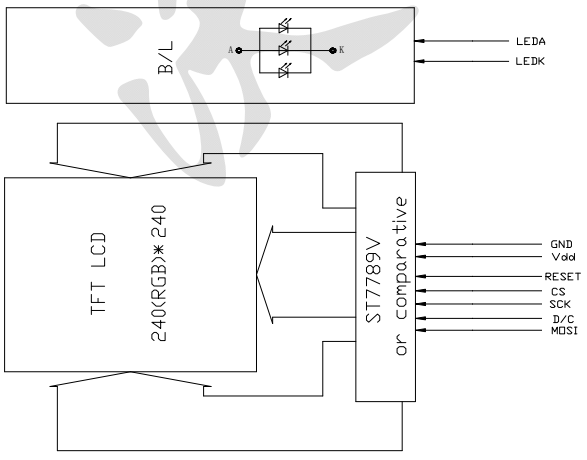
Input Signal and Power(12 Pins FPC Solder)

Pin NO.	Symbol 定义	I/O	Description 描述
1	GND	P	Power Ground 电源地
2	LEDK	P	Power supply for LED backlight Cathode input 背光发光二极管阴极
3	LEDA	P	Power supply for LED backlight Anodeinput 背光发光二极管阳极
4	VDD	I	Power supply for analogand logic 2.8/3.3V 屏幕电源脚
5-6	GND	P	Power Ground 电源地
7	DC	I	-Display data/command selection pin. DCX='1': display data or parameter. DCX='0': command data. 数据指令选择脚
8	CS	I	Chip select pin low action 片选脚
9	SCL(SCK)	I	SPI interface clock pin SPI 时钟信号
10	SDI(MOSI)	I/O	SPI interface input/output pin SPI 数据输入输出信号
11	RESET	I	This signal reset the device and it must be applied to properly initialize the chip. 复位脚
12	GND	P	Power Ground 电源地

8.3APPLICATION Schematic 应用原理图



9. BLOCK DIAGRAM 方框图

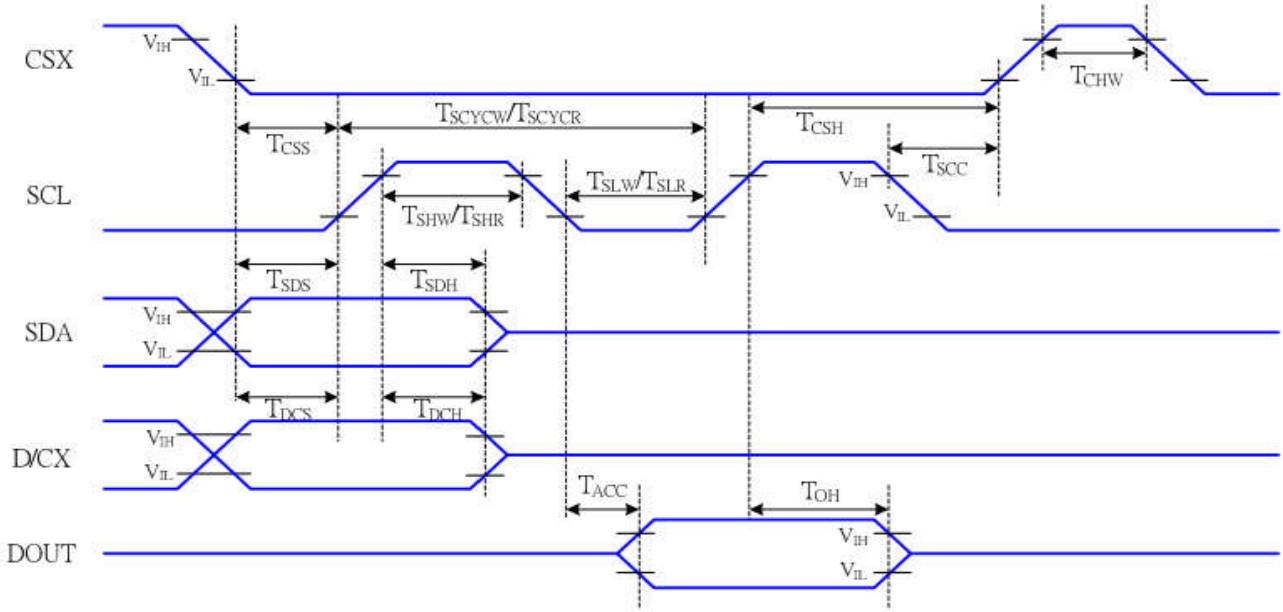


9.1 Initialization Code 初始化代码

```
LCD_RST_SET;                    delay_ms(10)
LCD_RST_CLR;                    delay_ms(100);
LCD_RST_SET;                    delay_ms(120);      //复位
LCD_WR_REG(0x11);               delay_ms(120);

LCD_WR_REG(0x36);
LCD_WR_DATA(0x00);
LCD_WR_REG(0x3A);
LCD_WR_DATA(0x05);
LCD_WR_REG(0x21);
LCD_WR_REG(0x2a);
LCD_WR_DATA(0x00);
LCD_WR_DATA(0x00);
LCD_WR_DATA(0x00);
LCD_WR_DATA(0xef);
LCD_WR_REG(0x2b);
LCD_WR_DATA(0x00);
LCD_WR_DATA(0x00);
LCD_WR_DATA(0x00);
LCD_WR_DATA(0xef);
//-------------------------------ST7789V Frame rate setting-----------------------------------//
LCD_WR_REG(0xb2);
LCD_WR_DATA(0x0c);
LCD_WR_DATA(0x0c);
LCD_WR_DATA(0x00);
LCD_WR_DATA(0x33);
LCD_WR_DATA(0x33);
LCD_WR_REG(0xb7);
LCD_WR_DATA(0x35);
//---------------------------------ST7789V Power setting---------------------------------------//
LCD_WR_REG(0xbb);
LCD_WR_DATA(0x1f);
LCD_WR_REG(0xc0);
LCD_WR_DATA(0x2c);
LCD_WR_REG(0xc2);
LCD_WR_DATA(0x01);
LCD_WR_REG(0xc3);
LCD_WR_DATA(0x12);
LCD_WR_REG(0xc4);
LCD_WR_DATA(0x20);
LCD_WR_REG(0xc6);
LCD_WR_DATA(0x0f);
LCD_WR_REG(0xd0);
LCD_WR_DATA(0xa4);
LCD_WR_DATA(0xa1);
//---------------------------------ST7789V gamma setting---------------------------------------//
LCD_WR_REG(0xe0);
LCD_WR_DATA(0xd0);
LCD_WR_DATA(0x08);
LCD_WR_DATA(0x11);
LCD_WR_DATA(0x08);
LCD_WR_DATA(0x0c);
LCD_WR_DATA(0x15);
LCD_WR_DATA(0x39);
LCD_WR_DATA(0x33);
LCD_WR_DATA(0x50);
LCD_WR_DATA(0x36);
LCD_WR_DATA(0x13);
LCD_WR_DATA(0x14);
LCD_WR_DATA(0x29);
LCD_WR_DATA(0x2d);

LCD_WR_REG(0xe1);
LCD_WR_DATA(0xd0);
LCD_WR_DATA(0x08);
LCD_WR_DATA(0x10);
LCD_WR_DATA(0x08);
LCD_WR_DATA(0x06);
LCD_WR_DATA(0x06);
LCD_WR_DATA(0x39);
LCD_WR_DATA(0x44);
LCD_WR_DATA(0x51);
LCD_WR_DATA(0x0b);
LCD_WR_DATA(0x16);
LCD_WR_DATA(0x14);
LCD_WR_DATA(0x2f);
LCD_WR_DATA(0x31);

LCD_WR_REG(0x29);       //Display on
LCD_WR_REG(0x2C);     //写数据到 Gram
```

10.TIMING CHARACTERISTICS 时序特性

10.1. Serial Interface Characteristics (4-line serial)



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)	16		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	7		ns	
	T_{SLW}	SCL "L" pulse width (Write)	7		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	7		ns	
	T_{SDH}	Data hold time	7		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

Table 6 4-line serial Interface Characteristics

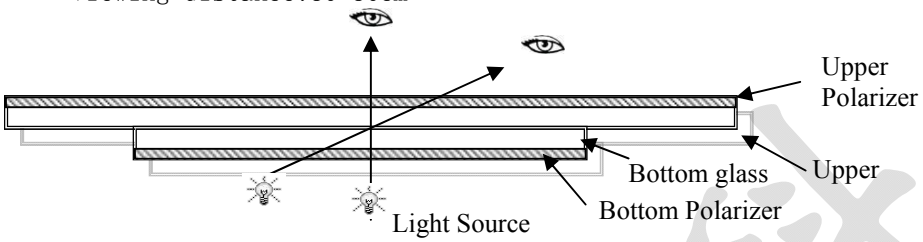
11.LCM Quality Criteria

11.1 VISUAL & FUNCTION INSPECTION STANDARD

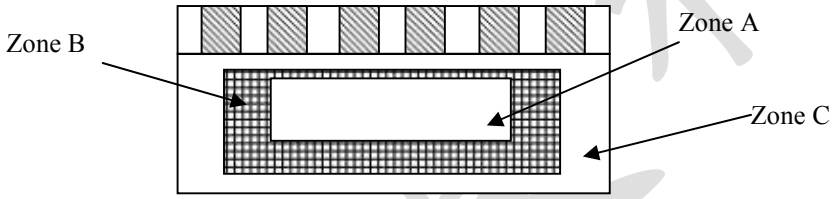
11.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

Temperature : 25±5℃
Humidity : 65%±10%RH
Viewing Angle : Normal viewing Angle.
Illumination: Single fluorescent lamp (300 to 700Lux)
Viewing distance:30-50cm



11.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)
Zone B : Viewing Area except Zone A
Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)
Note:
As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer.

11.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class Ⅱ
AQL:

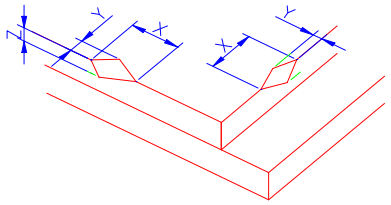
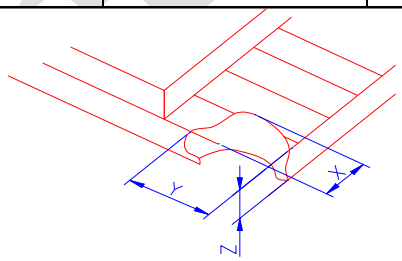
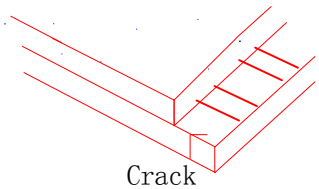
Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor

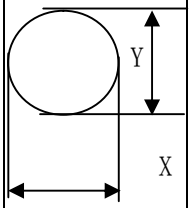
5	Soldering appearance	Good soldering , Peeling off is not allowed.	
6	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	

11.1.4 Criteria (Visual)

Number	Items	Criteria(mm)
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 X ≤3.0mm; Y <Inner border line of the seal; Z ≤T
	(2)LCD corner broken	 X ≤3.0mm; Y ≤L; Z ≤T
	(3) LCD crack	 Crack Not allowed

Number	Items	Criteria (mm)

2.0 Spot defect



Φ=(X+Y)/2

① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)

Size (mm) \ Zone	Acceptable Qty		
	A	B	C
Φ≤0.10	Ignore		Ignore
0.10<Φ≤0.15	3(distance≧10mm)		
0.15<Φ≤0.2	1		
0.2<Φ	0		

②Dim spot (LCD/TP/Polarizer dim dot, light leakage、dark spot)

Size (mm) \ Zone	Acceptable Qty		
	A	B	C
Φ≤0.1	Ignore		Ignore
0.1<Φ≤0.2	2(distance≧10mm)		
0.2<Φ≤0.3	1		
Φ>0.3	0		

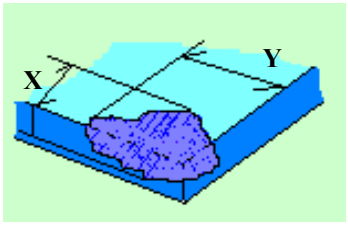
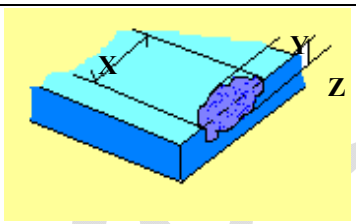
③ Polarizer accidented spot

Size (mm) \ Zone	Acceptable Qty		
	A	B	C
Φ≤0.2	Ignore		Ignore
0.2<Φ≤0.5	2(distance≧10mm)		
Φ>0.5	0		

Line defect (LCD/TP /Polarizer black/white line, scratch, stain)

Width(mm)	Length(mm)	Acceptable Qty		
		A	B	C
Φ≤0.03	Ignore	Ignore		Ignore
0.03<W≤0.05	L≤3.0	N≤2		
0.05<W≤0.08	L≤2.0	N≤2		
0.08<W	Define as spot defect			

<table>
<tr><td>3.0</td><td>Polarizer Bubble</td><td colspan="2">
<table>
<tr><td rowspan="2">Size (mm) \ Zone</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.2<Φ≤0.4</td><td colspan="2">2(distance≧10mm)</td></tr>
<tr><td>0.4<Φ≤0.6</td><td colspan="2">1</td></tr>
<tr><td>0.6<Φ</td><td colspan="2">0</td></tr>
</table>
</td></tr>
<tr><td>4.0</td><td>SMT</td><td colspan="2">According to IPC-A-610C class Ⅱ standard . Function defect and missing part are major defect ,the others are minor defect.</td></tr>
<tr><td rowspan="3">5.0</td><td rowspan="3">TP Related</td><td>TP bubble/ accidented spot</td><td>
<table>
<tr><td rowspan="2">Size Φ(mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1<Φ≤0.2</td><td colspan="2">2（distance≧10mm）</td></tr>
<tr><td>0.2<Φ≤0.3</td><td colspan="2">1</td></tr>
<tr><td>0.3<Φ</td><td colspan="2">0</td></tr>
</table>
</td></tr>
<tr><td>Assembly deflection</td><td>beyond the edge of backlight ≤0.15mm</td></tr>
<tr><td>Newton Ring</td><td>Newton Ring area>1/3 TP area
NG
Newton Ring area≤1/3 TP area
OK</td><td> 
</td></tr>
</table>

		TP corner broken X: length Y: width Z: height	X: X≤3.0mm; Y: Y≤3.0mm; Z: Z<LCD thickness * Circuitry broken is not allowed.	
		TP edge broken X: length Y: width Z: height	X: X≤6.0mm; Y: Y≤2.0mm; Z: Z<LCD thickness * Circuitry broken is not allowed.	

Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	TP no function	Not allowed

11.2 RELIABILITY TEST

NO	ITEM	CONDTTION	STANDARD
1	High Temp. Storage	70℃, 12 hours	1. Functional test is OK. Missing Segment, short, unclear segment, non-display, display abnormally and liquid crystal leak are un-allowed. 2. No low temperature bubbles, end seal loose and fall, frame rainbow.
2	Low Temp. Storage	-20℃, 12 hours	
3	High Temp. Operation	60℃, 12 hours	
4	Low Temp. Operation	-20℃, 12 hours	
5	High temperature and high Humidity storage	40℃,90%RH ,12 hours	
6	Thermal and cold shock	Static state, -20℃ (30 Min) ~70℃ (30 Min) ~ -20℃ (30Min), packaging, 10 cycles	
7	Vibration test	Packaging, Frequency : 10-55Hz Amplitude : 1.0mm, Each direction on X,Y axe 0.5 houre, circle 2 hours	1. Function test is OK. 2. No glass crack, chipped glass, end seal loose and fall, epoxy frame crack and so on. 3. No structure loose and fall.
8	Dropping test	Pack products into the carton box. Drop it from 80cm height to ground. Once for each side of the carton	

NOTE:

10.2.1 The reliability items will be fully performed in new sample qualification,

11.2.2 The reliability status will be tested as monitor during mass production. Individual reliability test shall be performed by lot , Moreover, the individual reliability item shall be decided according to reliability plan.

11.2.3 All samples are inspected after keeping in the room with normal temperature and humidity for 2 hours or above.

11.2.4 Vibration test: It is not necessary to test for those products without assembly frame , back light ,PCB and so on.

11.2.5 Dropping test : It is necessary for affirming new package.

11.2.6 For the high temperature and high humidity test, pure water of over 10 MΩ.cm should be used.

11.2.7 Each test item applies for test LCM only once .Then tested LCM cannot be used again in any other test item.

11.2.8 The quantity of LCM examination for each test item is 5pcs to 10pcs.

11.3Safetv instructions

11.3.1 If the LCD panel breaks, be careful not to get any liquid crystal substance in your mouth.

11.3.2 If the liquid crystal substance touches your skin or clothes, please wash it off immediately by using soap and water.

11.4 Handling Precautions

11.4.1 Avoid static electricity damaging the LSI.

11.4.2 Do not remove the panel or frame from the module .

11.4.3 The polarizing plate of the display is very fragile . So, please handle it very carefully.

11.4.4 Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of the plate.

11.4.5 The color tone of display and background of LCM has the possibility to be changed in the storage temperature range.

11.4.6 Pay attention to the working environment, as the element may be destroyed by static electricity.
--Be sure to ground human body and electric appliance during work.
--Avoid working in a dry environment to minimize the generations of static electricity.
--Static electricity may be generated when the protective film is fast peeled off.

11.4.7 When soldering the terminal of LCM, make certain the AC power source of soldering iron does not leak.

11.4.8 If the display surface becomes contaminated ,breathe on the surface and gently wipe it with a soft-dry-clean cloth .If it is heavily contaminated ,moisten cloth with the following solvent(ex:Ethyl alcohol).Solvents other than those above-mentioned may damage the polarizer(Especially ,do not use them .ex: Warter / Ketone)

11.5 Operation instructions

11.5.1 It is recommended to drive the LCD within the specified voltage limits, try to adjust the operating voltage for the optimal contrast, the color and contrast of LCD panel will varies at different temperature.

11.5.2 Response time is greatly delayed at low operating temperature range. However, this does not mean the LCD will be out of the order, It will recover when it returns to the specified temperature range.

11.5.3 If the display area is pushed hard during operation, the display will become abnormal.

11.5.4 Do not operate the LCD at the environments over the specified conditions, this may cause damage on the LCD and shorten the lifetime.

11.6 Storage instructions:

11.6.1 Store LCDs in a sealed polyethylene bag.

11.6.2 Store LCDs in a dark place, Do not expose to sunlight or fluorescent light. Keep the temperature between 0℃and 35℃.

11.6.3 Avoid the polarizer touch any other object, (It is recommended to store them in the container in which they were shipped.)

11.7 Limited Warranty

11.7.1 LEAD will replace or repair any of its LCD modules, which are found to be defective, when inspected in accordance with LEAD LCM acceptance standards (copies available upon request) for a period of 12 months from ink- print date on product

11.7.2 Any defects must be returned to LEAD within 60 days since ship-out. Confirmation of such date shall be based on freight documents. The warranty liability of LEAD limited to repair and/or replacement on defects above (7.1,7.2)

11.7.3 No warranty can be granted if the precautions stated above have been disregarded. The typical samples are as below:

-- LCD glass crack/break

--PCB outlet is damaged or modified.

--PCB conductors damaged.

--Circuit modified with by grinding, engraving or painting varnish.

--FPC crack

11.7.4 Modules must be returned with sufficient description of the failures of defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB outlet, conductors and terminals. Modules must be packed with the container in which they were shipped.

10.Packing method

------TBD-------