


SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
MODEL	SCC0055-V01
CUSTOMER APPROVED	

APPROVED BY	CHECKED BY	ORGANIZED BY
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0158

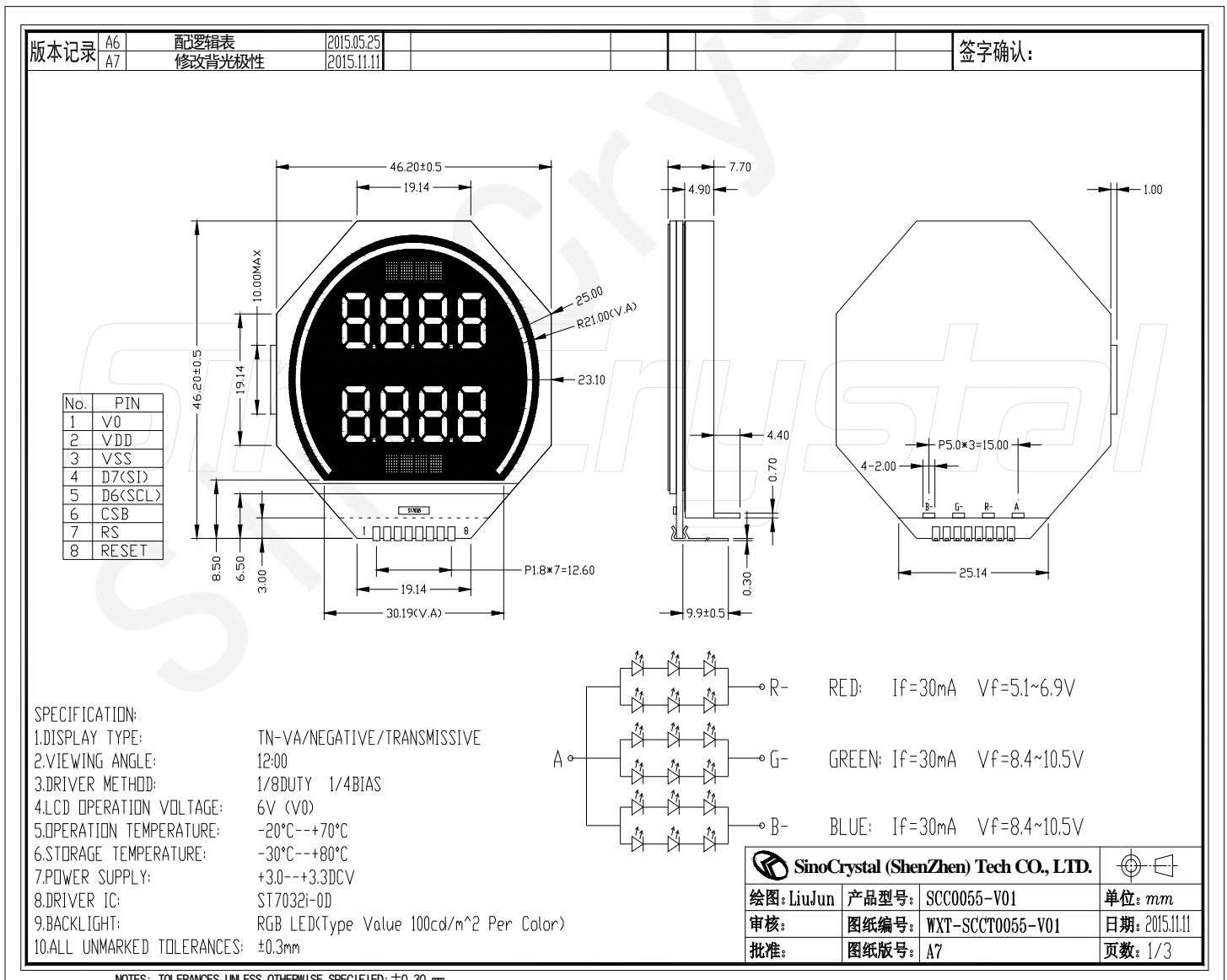
Specification Revision History

Version	Content	Date
A0	First Issue	2015-12-22

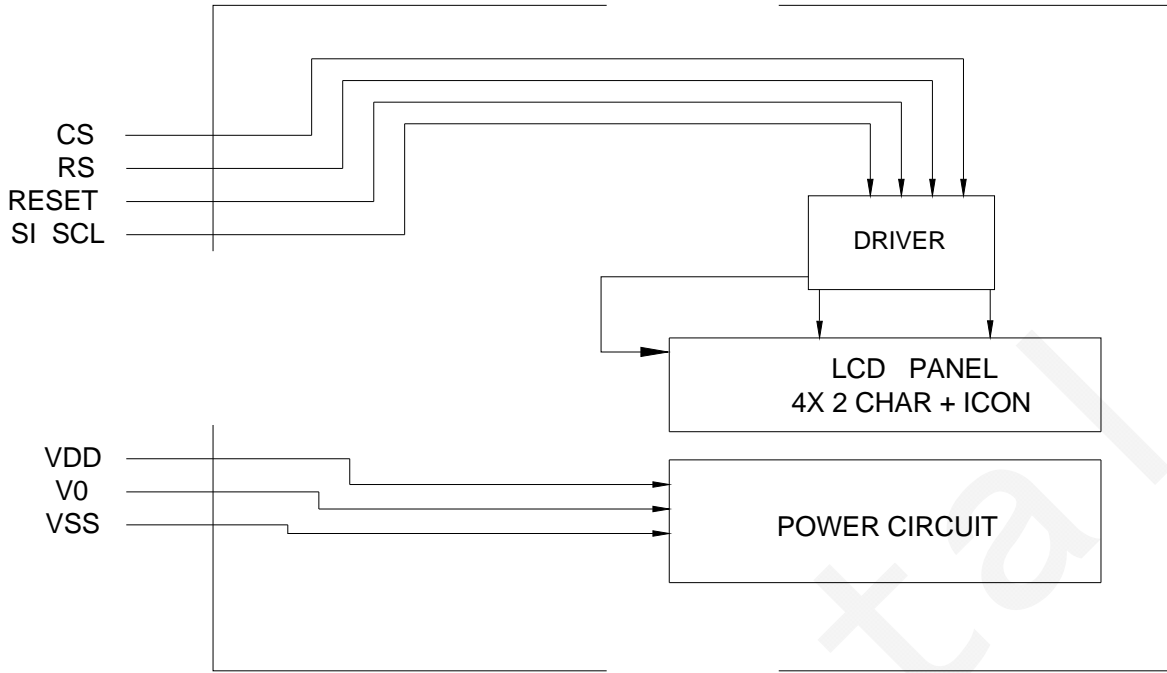
1. PHYSICAL DATA

ITEM	STANDARD VALUE	UNIT
NUMBER OF CHARACTER	4x2 + ICON	Mm
MODULE DIMENSION	46.2×46.2×7.7	Mm
VIEWING AREA	42.0×35.6	Mm
DOT SIZE	0.38×0.35	Mm
DOT PITCH	0.42×0.39	Mm
LCD TYPE	TN-VA/NEGATIVE/TRANSMISSIVE	
DUTY	1/8	
VIEWING DIRECTION	12:00	o'clock
BACK LIGHT TYPE	SIDE LIT LED	
BACK LIGHT COLOR	RGB COLOR	
APPROX. WEIGHT	TBD	G

2. EXTERNAL DIMENSIONS



3. BLOCK DIAGRAM



4. INTERFACE PIN CONNECTIONS

Pin No.	Symbol	Level	Description
1	V0	--	Supply voltage for LCD
2	VDD	--	Supply voltage for logic
3	VSS	--	Ground
4	D7(SI)	H/L	serial data input
5	D6(SCL)	H/L	the serial clock input
6	CSB	H/L	Chip select signal
7	RS	H/L	Register selection input H : display data. L : control data
8	RESET	H/L	Chip reset signal

5. ABSOLUTE MAXIMUM RATINGS

(1) Electrical Absolute Ratings

Item	Symbol	Min.	Max.	Unit	Note
Power Supply for Logic	VDD	-0.3	6.0	Volt	Note 1
Power Supply for LCD	V0	-0.3	7.0	Volt	
Input Voltage	V _I	-0.3	VDD	Volt	
Current for LED backlight	I _{LED}		30mA	mA	One Color

Note 1: Operator should be grounded during handling LCM

(2) Environmental Absolute Maximum Ratings

Item	Normal Temperature				Wide Temperature			
	Operating		Storage		Operating		Storage	
	Min.	Max,	Min.	Max,	Min.	Max,	Min.	Max,
Ambient Temperature	0°C	+50°C	-10°C	+60°C	-20°C	+70°C	-30°C	+80°C
Humidity(without condensation)	Note 2,4		Note 3,5		Note 4,5		Note 4,6	

Note 2 Ta ≤ 50°C : 80% RH max

Ta > 50°C : Absolute humidity must be lower than the humidity of 85%RH at 50°C

Note 3 Ta at -20°C will be < 48hrs at 70°C will be < 120hrs when humidity is higher than 75%.

Note 4 Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 5 Ta ≤ 70°C : 75RH max

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

Note 6 Ta at -20°C will be < 48hrs, at 80°C will be < 120hrs when humidity is higher than 75%.

6. ELECTRICAL CHARACTERISTICS

DC Characteristics

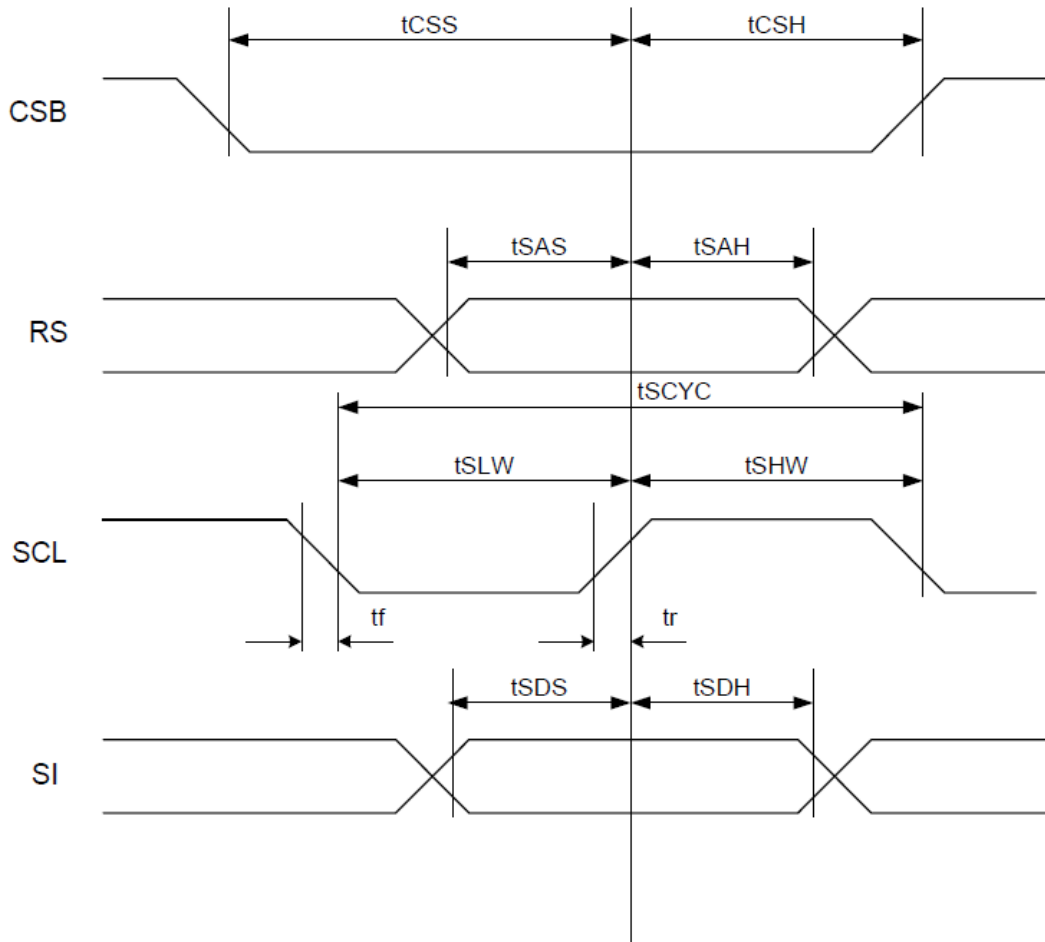
(VSS=0V, VDD=2.7-4.5V, Ta=25°C)

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power Supply for Logic	VDD		2.7	-	4.5	Volt
Input Voltage	V _{IH}		1.9	-	VDD	Volt
	V _{IL}		-0.3	-	0.8	Volt
Output Voltage	V _{OH}	I _{OUT} =1mA	0.75VDD	-	VDD	Volt
	V _{OL}	I _{OUT} =-1mA	-	-	0.8	Volt
LCM Recommend LCD Module Driving Voltage	V _{LCD}	T _a =0°C	-	5.87	-	Volt
		T _a =25°C		5.87		
		T _a =50°C	-	5.63	-	
Power Supply Current for LCM	I _{DD} (BL OFF)	-	-	-	2	mA
	I _{DD} (BL ON)	-	-	-	92	
Power Supply for LED Backlight	V _{BLA} - V _{BLK}	Ta=25°C	-	-	10.5	V

(VSS=0V, VDD=4.5-5.5V, Ta=25°C)

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power Supply for Logic	VDD		4.5	-	5.5	Volt
Input Voltage	V _{IH}		2.7	-	VDD	Volt
	V _{IL}		-0.3	-	0.8	Volt
Output Voltage	V _{OH}	I _{OUT} =1mA	3.8	-	VDD	Volt
	V _{OL}	I _{OUT} =-1mA	-	-	0.8	Volt
LCM Recommend LCD Module Driving Voltage	V _{LCD}	T _a =0°C	-	5.87	-	Volt
		T _a =25°C		5.87		
		T _a =50°C	-	5.63	-	
Power Supply Current for LCM	I _{DD} (BL OFF)	-	-	-	2	mA
	I _{DD} (BL ON)	-	-	-	92	
Power Supply for LED Backlight	V _{BLA} - V _{BLK}	Ta=25°C	-	-	10.5	V

AC Characteristics



(Ta = 25°C)

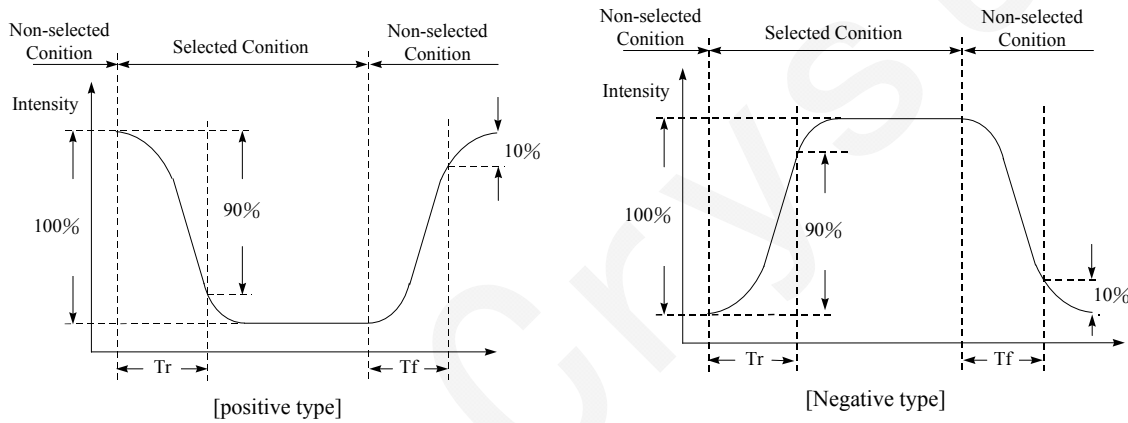
Item	Signal	Symbol	Condition	VDD=2.7 to 4.5V Rating		VDD=4.5 to 5.5V Rating		Units
				Min.	Max.	Min.	Max.	
Serial Clock Period	SCL	tscyc	—	200	-	100	-	ns
SCL "H" pulse width		tshw		20	-	20	-	
SCL "L" pulse width		tslw		160	-	120	-	
SCL Rise/Fall time	SCL	tr,tf	—	-	20	-	20	ns
Address setup time	RS	tsas	—	10	-	10	-	ns
Address hold time		tsah		250	-	150	-	
Data setup time	SI	tlds	—	10	-	10	-	ns
Data hold time		tldh		10	-	20	-	
CS-SCL time	CS	tcss	—	20	-	20	-	ns
		tchsh		350	-	200	-	

*1 All timing is specified using 20% and 80% of VDD as the standard.

7. ELECTRO-OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	note
Viewing angle range	θ_f (12 o'clock)	When $Cr \geq 2$	---	60	---	Degree	Note 2 Note 3 Note 4
	θ_b (6 o'clock)		---	20	---		
	θ_l (9 o'clock)		---	45	---		
	θ_r (3 o'clock)		---	45	---		
Rise Time	T_r	$V_0-V_{SS}=10.5V$ $T_a=25^\circ C$		112		mS	Note 1
Fall Time	T_f			250			
Contrast	Cr		---	5.4	---		

[Note 1] Definition of Response Time (T_r , T_f)

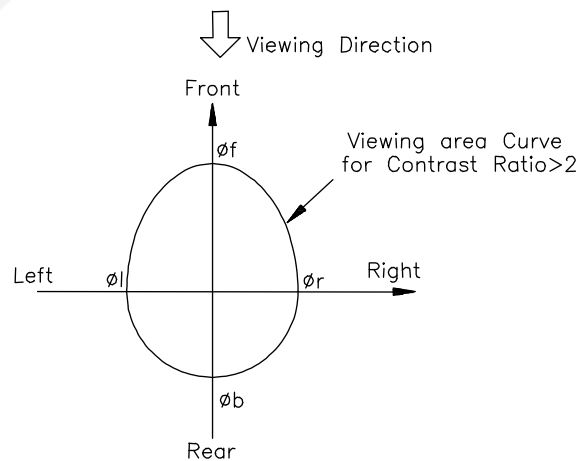


Conditions:

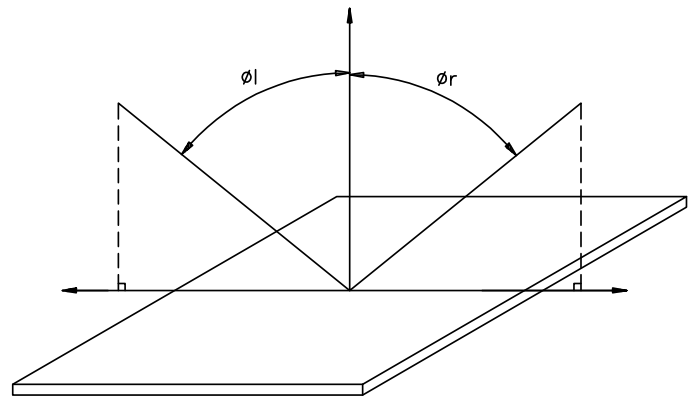
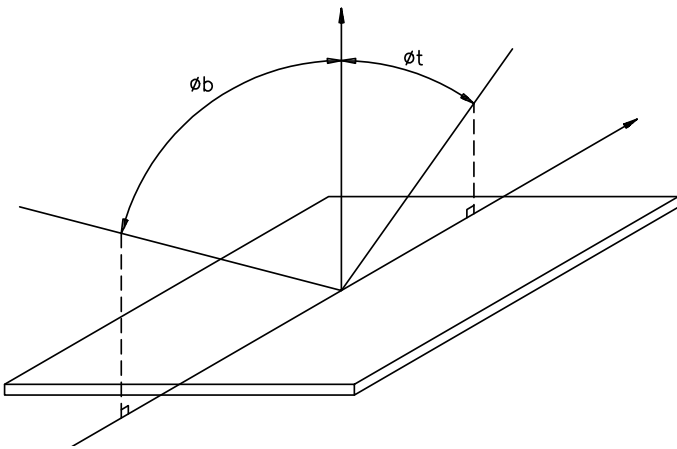
Operating Voltage : V_{op}
Frame Frequency : 64 Hz

Viewing Angle(θ , φ): 0° , 0°
Driving Wave form : 1/N duty, 1/a bias

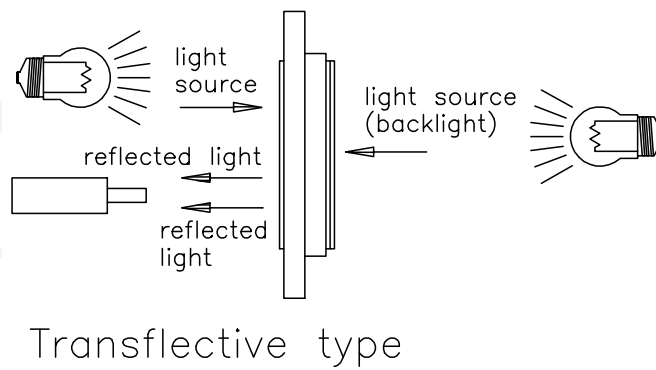
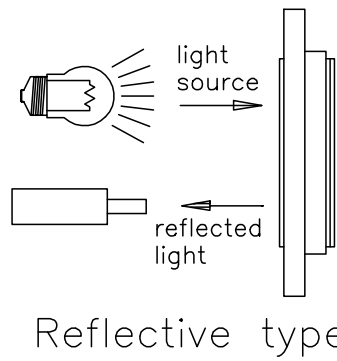
[Note 2] Definition of Viewing Direction



[Note 3] Definition of viewing angle



[Note 4] Description of Measuring Equipment



8. OPERATING PRINCIPLES & METHODS

ST7032 support 2 command mode, SCC0055 is Extension mode, EXT have been connected to VSS.

➤ **instruction table at “Extension mode”**

(when “EXT” option pin connect to VSS, the instruction set follow below table)

Instruction	Instruction Code										Description	Instruction Execution Time		
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		OSC=380KHz	OSC=540kHz	OSC=700KHz
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.08 ms	0.76 ms	0.59 ms
Return Home	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.08 ms	0.76 ms	0.59 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	26.3 us	18.5 us	14.3 us
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1:entire display on C=1:cursor on B=1:cursor position on	26.3 us	18.5 us	14.3 us
Function Set	0	0	0	0	1	DL	N	DH	*0	IS	DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS: instruction table select	26.3 us	18.5 us	14.3 us
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	26.3 us	18.5 us	14.3 us
Read Busy flag and address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0	0	0
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM/ICONRAM)	26.3 us	18.5 us	14.3 us
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/ICONRAM)	26.3 us	18.5 us	14.3 us

Note * : this bit is for test command , and must always set to “0”

Instruction table 0(IS=0)

Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	S/C and R/L: Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	26.3 us	18.5 us	14.3 us
Set CGRAM	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	26.3 us	18.5 us	14.3 us

Instruction table 1(IS=1)

Internal OSC frequency	0	0	0	0	0	1	BS	F2	F1	F0	BS=1:1/4 bias BS=0:1/5 bias F2~0: adjust internal OSC frequency for FR frequency.	26.3 us	18.5 us	14.3 us
Set ICON address	0	0	0	1	0	0	AC3	AC2	AC1	AC0	Set ICON address in address counter.	26.3 us	18.5 us	14.3 us
Power/ICON control/Contrast set	0	0	0	1	0	1	Ion	Bon	C5	C4	Ion: ICON display on/off Bon: set booster circuit on/off C5,C4: Contrast set for internal follower mode.	26.3 us	18.5 us	14.3 us
Follower control	0	0	0	1	1	0	Fon	Rab2	Rab1	Rab0	Fon: set follower circuit on/off Rab2~0: select follower amplified ratio.	26.3 us	18.5 us	14.3 us
Contrast set	0	0	0	1	1	1	C3	C2	C1	C0	Contrast set for internal follower mode.	26.3 us	18.5 us	14.3 us

NOTE: For more detail information, please refer to the ST7032’s specification.

9. Display Data RAM (DDRAM)

Display data RAM (DDRAM) stores display data represented in 8-bit character codes. Its extended capacity is 80

x 8 bits, or 80 characters. The area in display data RAM (DDRAM) that is not used for display can be used as general data RAM. See Figure 7 for the relationships between DDRAM addresses and positions on the liquid crystal display.

The DDRAM address (A_{DD}) is set in the address counter (AC) as hexadecimal.

Display Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DDRAM Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
For Shift Left	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10
	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50
For Shift Right	27	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E
	67	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E

NOTE: For more detail information, please refer to the ST7032's specification.

Product Number	OPR1	OPR2	Support Character
ST7032-0D	1	0	English/Japan/European

ST7032-0D (ITO option OPR1=1, OPR2=0)

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	Replaced By CGRAM Pattern	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î
0001		Ï	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	¸	¹	º	»	¼	½
0010		´	µ	¶	·	¸	¹	º	»	¼	½	¾	¿	À	Á	Â
0011		Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï	Ð	Ñ
0100		Ò	Ó	Ô	Õ	Ö	×	¸	¹	º	»	¼	½	¾	¿	À
0101		Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï
0110		Ð	Ñ	Ò	Ó	Ô	Õ	Ö	×	¸	¹	º	»	¼	½	¾
0111		À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î
1000	¸	¹	º	»	¼	½	¾	¿	À	Á	Â	Ã	Ä	Å	Æ	
1001	Ç	È	É	Ê	Ë	Ì	Í	Î	Ï	Ð	Ñ	Ò	Ó	Ô	Õ	
1010	¸	¹	º	»	¼	½	¾	¿	À	Á	Â	Ã	Ä	Å	Æ	
1011	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	
1100	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	
1101	¸	¹	º	»	¼	½	¾	¿	À	Á	Â	Ã	Ä	Å	Æ	
1110	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	
1111	À	Á	Â	Ã	Ä	Å	Æ	Ç	È	É	Ê	Ë	Ì	Í	Î	

10.RELIABILITY

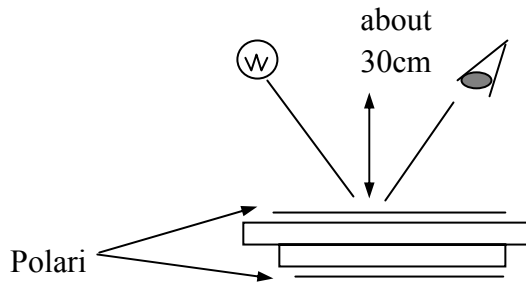
Environmental Test				
No.	Test Item	Content of Test	Test Condition	Applicable Standard
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	80 °C 200 hrs	-----
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30 °C 200 hrs	-----
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70 °C 200 hrs	-----
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-20 °C 200 hrs	-----
5	High temperature / Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	70 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
6	High temperature / Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	50 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. $ \begin{array}{c} -10^{\circ}\text{C} \rightleftharpoons 25^{\circ}\text{C} \rightleftharpoons 60^{\circ}\text{C} \\ \xleftarrow{30\text{min}} \quad \xrightarrow{5\text{min}} \quad \xleftarrow{30\text{min}} \\ \text{1 cycle} \end{array} $	-10°C / 60°C 10 cycles	-----
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz → 1.5mmp-p 22~500Hz → 1.5G Total 0.5hrs	MIL-202E-201A JIS-C5025 JIS-C7022-A-10
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G half sign wave 11 msedc 3 times of each direction	MIL-202E-213B
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115 mbar 40 hrs	MIL-202E-105C
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V , RS=1.5 kΩ CS=100 pF 10 time	MIL-883B-3015.1
Inspection after test: Inspection after 2~4 hours storage at room temperature ,the sample shall be free from defects: <ol style="list-style-type: none"> Air bubble in the LCD. Sealleak Non-display. Missing segments. Glass crack. Current Idd is twice higher than initial value. 				

11. QUALITY GUARANTEE

1、Appearance inspection conditions

Must be in the lighting of the fluorescent lamp 30W conditions: room 1000LU, visual distance 30cm±5mm test

LCM visual inspection direction is perpendicular to the line around 45°

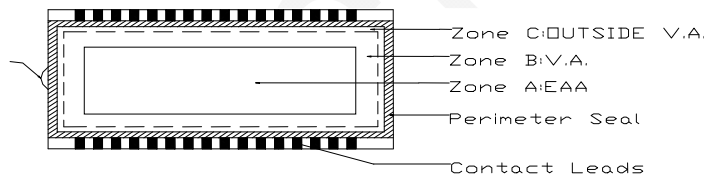


2、Area definition

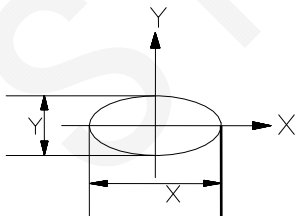
A region: the visual area is defined as the effective display area, known as the A zone

B region: effective display area outside, visual area known as B area

C region: visual area outside invalid display area known as C area



3、Point size D Calculation



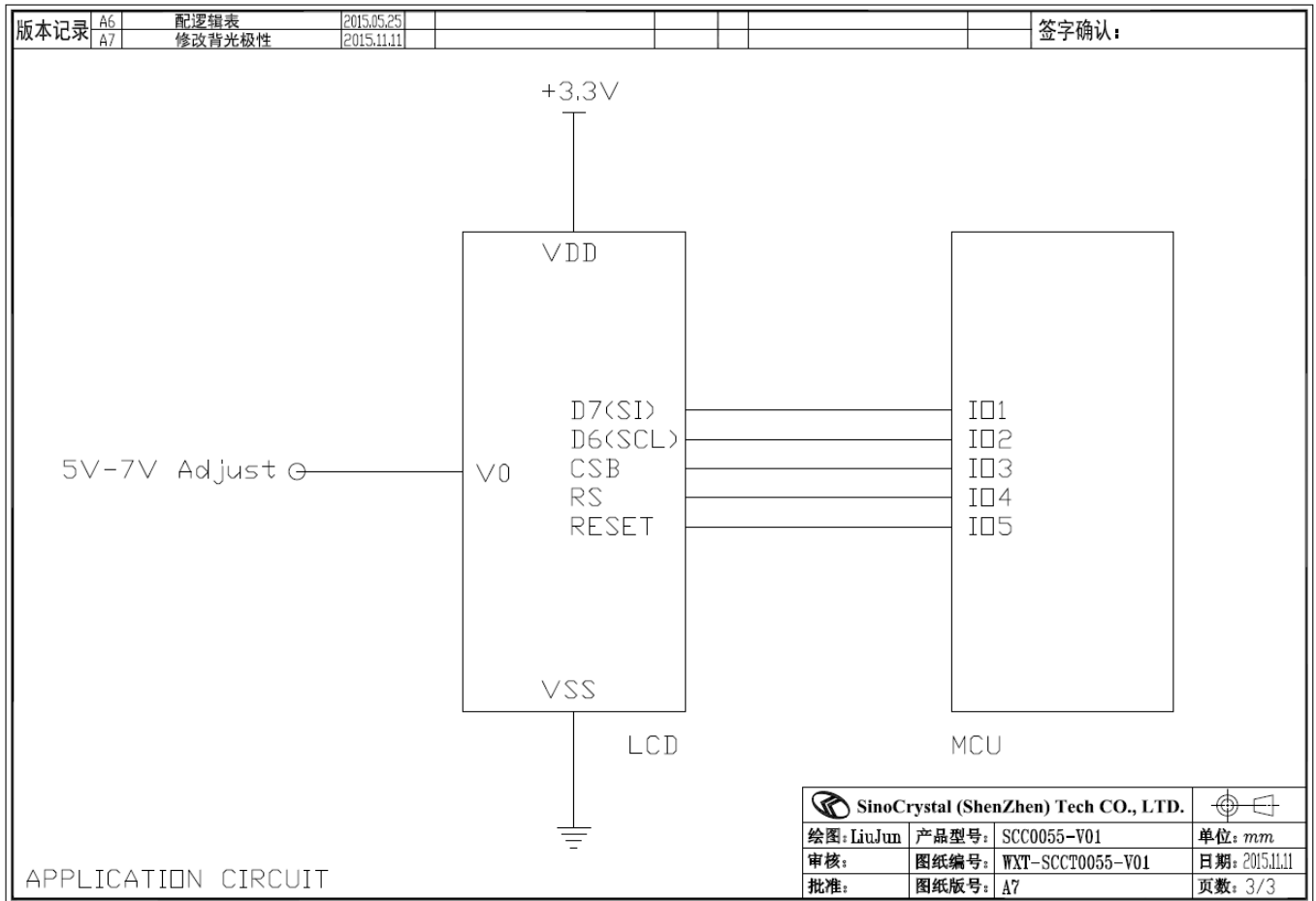
$$D = (X + Y) / 2$$

If the defect length to width is more than 2.5 times, as scratch and scratch defects

No	Item	Criteria																		
1	inclusions (black spot, white spot, dust)	(1)round type <table border="1" style="margin-left: 20px;"> <thead> <tr> <th rowspan="2">D</th> <th colspan="3">Judgment standard</th> </tr> <tr> <th>A Area</th> <th>B Area</th> <th>C Area</th> </tr> </thead> <tbody> <tr> <td>D<0.15</td> <td colspan="3">neglect</td> </tr> <tr> <td>0.15≤D≤0.2</td> <td>2</td> <td>3</td> <td rowspan="2">neglect</td> </tr> <tr> <td>D>0.2</td> <td>0</td> <td>0</td> </tr> </tbody> </table>	D	Judgment standard			A Area	B Area	C Area	D<0.15	neglect			0.15≤D≤0.2	2	3	neglect	D>0.2	0	0
		D		Judgment standard																
A Area	B Area		C Area																	
D<0.15	neglect																			
0.15≤D≤0.2	2	3	neglect																	
D>0.2	0	0																		
		(2)linear type <table style="margin-left: 20px;"> <thead> <tr> <th>length mm(L)</th> <th>width mm(W)</th> <th>no. of defect</th> </tr> </thead> <tbody> <tr> <td>na</td> <td>W≤0.02</td> <td>neglect</td> </tr> <tr> <td>L≤3</td> <td>0.03 < W ≤0.08</td> <td>2</td> </tr> <tr> <td>3 < L</td> <td>0.08 < W</td> <td>none</td> </tr> </tbody> </table>	length mm(L)	width mm(W)	no. of defect	na	W≤0.02	neglect	L≤3	0.03 < W ≤0.08	2	3 < L	0.08 < W	none						
length mm(L)	width mm(W)	no. of defect																		
na	W≤0.02	neglect																		
L≤3	0.03 < W ≤0.08	2																		
3 < L	0.08 < W	none																		
2	scratch	1. scratch on protective film is permitted. 2. scratch on polarizer shall be as follow: (1)round type <table style="margin-left: 20px;"> <thead> <tr> <th>diameter mm(a*)</th> <th>no of defect</th> </tr> </thead> <tbody> <tr> <td>a≤0.15</td> <td>neglect</td> </tr> <tr> <td>0.15 < a ≤0.20</td> <td>2 max</td> </tr> <tr> <td>0.20 < a</td> <td>none</td> </tr> </tbody> </table> (2)linear type be judged by 1.-(2) linear type	diameter mm(a*)	no of defect	a≤0.15	neglect	0.15 < a ≤0.20	2 max	0.20 < a	none										
diameter mm(a*)	no of defect																			
a≤0.15	neglect																			
0.15 < a ≤0.20	2 max																			
0.20 < a	none																			
3	dent	diameter < 1.5mm																		
4	bubble	not exceeding 0.5mm average diameter is acceptable between glass and polarizing film																		
5	pin hole	(a+b)/2 ≤ 0.15mm maximum number: ignored 0.15 < (a+b)/2 ≤ 0.20mm maximum number: 10																		
6	dot width	design width ±15%																		
7	dot defect	(a+b)/2 ≤ 0.20mm maximum number: ignored 0.20 < (a+b)/2 ≤ 0.30mm maximum number: 5 x=width																		
8	contrast irregularity(spot)	diameter spec no of defect a ≤ 0.50mm neglect 0.50 < a ≤ 0.75 5 0.75 < a ≤ 1.00 3 1.00 < a none																		
9	color tone and uniformity	obvious uneven color is not permitted																		

12. EXAMPLE

1) Application Circuit



2) Demo Program

```
// SCC0055 Test program (ST7032 扩展命令模式 EXT=0)
//*****
//Creat by LiuJun 13510533847@163.com *
//*****
//MCU = STC11F60XE Fosc=22.1184M Hz *
//*****
#include<reg51.h>
#include<intrins.h>

sbit CS = P1^5; //片选
sbit RST = P1^3; //复位
sbit RS = P1^4; //数据指令选择
sbit SCK = P1^6; //Clock 信号
sbit SDA = P1^7; //数据
sbit Key = P2^1;

//串口模式下只能写不能读,也不能查忙,因此用户要控制好速度不要太快
void LCD_WriteCmd( unsigned char CommandByte )
{
    unsigned char i;
    CS=0;
    RS=0; //Command
    for(i=0;i<8;i++)
    {
        SCK=1;
        SDA=( CommandByte>>(7-i) &0x01);
        _nop_();_nop_();_nop_();
        SCK=0;
        _nop_();_nop_();_nop_();
        SCK=1;
    }
}
```

```

}

void LCD_WriteData( unsigned char DataByte )
{
    unsigned char i;
    CS=0;
    RS=1;          //Data
    for(i=0;i<8;i++)
    {
        SCK=1;
        SDA=( DataByte>>(7-i)) &0x01);
        _nop_();_nop_();_nop_();
        SCK=0;
        _nop_();_nop_();_nop_();
        SCK=1;
    }
}

```

```

void DelayUS(unsigned int US)
{
    unsigned char i;
    while(US!=0)
    {
        for(i=0;i<3;i++);
        US--;
    }
}

```

```

void DelayMS(unsigned int MS)
{
    //For 40M STC89C516 : usn=9 us=182
    //For 22.1184 STC11F60 : usn=45 us=182
    unsigned char us, usn, i;
    while(MS!=0)
    {
        usn = 45;
        while(usn!=0)
        {
            us=182;
            while (us!=0) {us--;};
            usn--;
        }
        for(i=0;i<3;i++);
        MS--;
    }
}

```

```

void DelayKey(unsigned int Second , unsigned int MS100)
{
    unsigned int i;
    for(i=0;i<Second*100+MS100*10;i++)
    {
        if(Key==0)
        {
            DelayMS(20);
            while(Key==0) {DelayMS(20);}
            break;
        }
        else DelayMS(10);
    }
}

```

//初始化液晶

```

void LCD_Init(void)
{
    RST = 0;
    DelayMS(100);
    RST = 1;
    DelayMS(50);
    LCD_WriteCmd(0x38); //Fuction Set: 8bit MCU interface,1 Line Display,5*8 Font. IS=0      26.3us
    DelayMS(1);
    LCD_WriteCmd(0x38); //Fuction Set: 8bit MCU interface,1 Line Display,5*8 Font. IS=0      26.3us
    DelayMS(1);
    LCD_WriteCmd(0x38); //Fuction Set: 8bit MCU interface,2 Line Display,5*8 Font. IS=0      26.3us
    DelayMS(1);
    LCD_WriteCmd(0x06); //Entry Mode: cursor/blink left->right,Shift of entire display disable. 26.3us
    DelayMS(1);
    LCD_WriteCmd(0x39); //Fuction Set: 8bit MCU interface,2 Line Display,5*8 Font. IS=1      26.3us
    DelayMS(1);
    LCD_WriteCmd(0x1C); //Bias=1/4, OSC frequency=100b      26.3us
    DelayMS(1);
    LCD_WriteCmd(0x58); //ICON ON,Booster OFF      26.3us
}

```

```

DelayMS(1);
LCD_WriteCmd(0x38); //Fuction Set: 8bit MCU interface, 2 Line Display, 5*8 Font.  IS=0      26.3us
DelayMS(1);
LCD_WriteCmd(0x01); //Clear Display and AC==00H      1.08ms
DelayMS(2);
LCD_WriteCmd(0x0C); //Display ON      26.3us
DelayMS(1);
}

unsigned char code CUSTOM[]={
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, //自定义 1, 留给 ICON 用
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, //自定义 2, 留给 ICON 用
0x10, 0x06, 0x09, 0x08, 0x08, 0x09, 0x06, 0x00, //℃
0xff, 0x11, 0x11, 0x11, 0x11, 0x11, 0xff, 0xff, //方框, 5x7 方框
0x15, 0x0a, 0x15, 0x0a, 0x15, 0x0a, 0x15, 0x0a, //网点
0x0a, 0x15, 0x0a, 0x15, 0x0a, 0x15, 0x0a, 0x15, //网点
0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, 0xff, //全黑
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, //全白
};

//设置 CGRAM 自定义字符
void LCD_SetCGRAM( void )
{
    unsigned char i;
    LCD_WriteCmd(0x40); //26.3us
    DelayUS(50);
    for(i=0;i<64;i++)
    {
        LCD_WriteData( CUSTOM[i] ); //26.3us
        DelayUS(50);
    }
}

//设计在普通 COM 上的 ICON 利用 CGRAM 来控制显示字符
unsigned char code ICON1[]={
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xFF, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0xFF, 0x00,

0x00, 0x00, 0x00, 0x00, 0xFF, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0xFF, 0x00, 0x00, 0x00,

0x00, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,

0xFF, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0xFF, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,

0x00, 0x00, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00,

0x00, 0x00, 0x00, 0x00, 0x00, 0xFF, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0xFF, 0x00, 0x00,

0x00, 0x00, 0x00, 0xFF, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0xFF, 0x00, 0x00, 0x00, 0x00,

0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0x00,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0x00,

0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00,
};

//利用设置 CGRAM 来显示 ICON
void Disp_ICON1( unsigned char n )
{
    unsigned char i;
    LCD_WriteCmd(0x40); //26.3us
    DelayUS(50);
    for(i=0;i<16;i++)
    {
        LCD_WriteData( ICON1[16*n+i] ); //26.3us
        DelayUS(50);
    }

    LCD_WriteCmd(0xC0+4); //26.3us
    DelayUS(50);
    for(i=0;i<2;i++)
    {
        LCD_WriteData(i); //26.3us
        DelayUS(50);
    }
}

```

```
//利用设置 ICON RAM 来显示 ICON
void Disp_ICON2( unsigned char n )
{
    LCD_WriteCmd(0x39); //Fuction Set: 8bit MCU interface, 2 Line Display, 5*8 Font.   IS=1           26. 3us
    DelayMS(1);
    if(n)
    {
        LCD_WriteCmd(0x40+4); //26. 3us
        DelayUS(50);
        LCD_WriteData( 0x1F ); //26. 3us
        DelayUS(50);
        LCD_WriteData( 0x1F ); //26. 3us
        DelayUS(50);
        LCD_WriteCmd(0x40+10); //26. 3us
        DelayUS(50);
        LCD_WriteData( 0x1F ); //26. 3us
    }
    else
    {
        LCD_WriteCmd(0x40+4); //26. 3us
        DelayUS(50);
        LCD_WriteData( 0x00 ); //26. 3us
        DelayUS(50);
        LCD_WriteData( 0x00 ); //26. 3us
        DelayUS(50);
        LCD_WriteCmd(0x40+10); //26. 3us
        DelayUS(50);
        LCD_WriteData( 0x00 ); //26. 3us
    }
    LCD_WriteCmd(0x38); //Fuction Set: 8bit MCU interface, 2 Line Display, 5*8 Font.   IS=0           26. 3us
    DelayMS(1);
}
}
```

```
void FillRAM(unsigned char put)
{
    unsigned char i;
    LCD_WriteCmd(0xC0); //26. 3us
    DelayUS(50);
    for(i=0;i<4;i++)
    {
        LCD_WriteData(put); //26. 3us
        DelayUS(50);
    }
    LCD_WriteCmd(0xC0+6); //26. 3us
    DelayUS(50);
    for(i=0;i<4;i++)
    {
        LCD_WriteData(put); //26. 3us
        DelayUS(50);
    }
}
}
```

```
//显示 ASCII 字符串
unsigned char Row1PutStr(unsigned char code *puts)
{
    LCD_WriteCmd(0xC0+6); //26. 3us
    DelayUS(50);
    while(*puts != '\0') //判断字符串时候显示完毕
    {
        LCD_WriteData(*puts); //26. 3us
        puts++;
        DelayUS(50);
    }
    return 1;
}
}
```

```
//显示 ASCII 字符串
unsigned char Row2PutStr(unsigned char code *puts)
{
    LCD_WriteCmd(0xC0); //26. 3us
    DelayUS(50);
    while(*puts != '\0') //判断字符串时候显示完毕
    {
        LCD_WriteData(*puts); //26. 3us
        puts++;
        DelayUS(50);
    }
    return 1;
}
}
```

```
//主函数
void main(void)
{
    DelayMS(50);
    LCD_Init();
    LCD_SetCGRAM();
    while(1)
    {
        FillRAM(3);
        Disp_ICON1(0);
        DelayKey(1,0);

        FillRAM(4);
        Disp_ICON1(1);
        DelayKey(1,0);

        Row1PutStr("1111");
        Row2PutStr("1111");
        Disp_ICON1(2);
        DelayKey(1,0);

        Row1PutStr("2222");
        Row2PutStr("2222");
        Disp_ICON1(3);
        DelayKey(1,0);

        Row1PutStr("3333");
        Row2PutStr("3333");
        Disp_ICON1(4);
        DelayKey(1,0);

        Row1PutStr("4444");
        Row2PutStr("4444");
        Disp_ICON1(5);
        DelayKey(1,0);

        Row1PutStr("5555");
        Row2PutStr("5555");
        Disp_ICON1(6);
        DelayKey(1,0);

        Row1PutStr("6666");
        Row2PutStr("6666");
        Disp_ICON1(8);
        Disp_ICON2(1);
        DelayKey(1,0);

        FillRAM(6);
        Disp_ICON1(7);
        Disp_ICON2(1);
        DelayKey(1,0);

        FillRAM(7);
        Disp_ICON1(8);
        Disp_ICON2(0);
        DelayKey(1,0);
    }
}
```

13. USING LCD MODULES

13-1. Liquid Crystal Display Modules

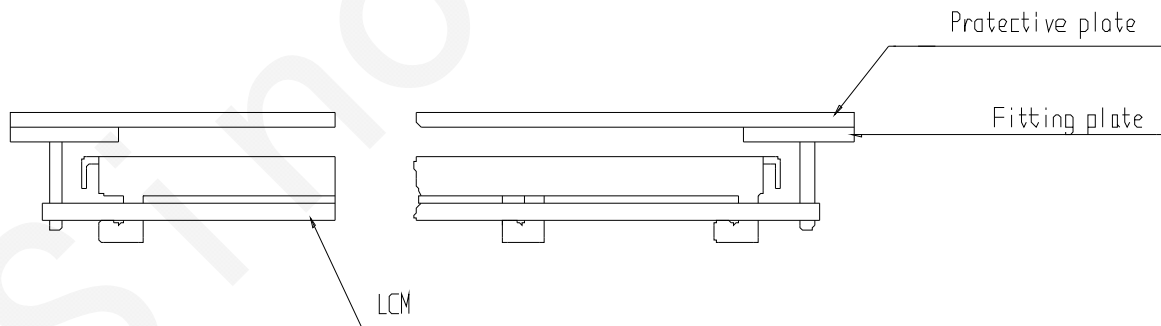
LCD is composed of glass and polarizer. Pay attention to the following items when handling.

- (1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.
- (2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).
- (3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.
- (4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. Do not scrub hard to avoid damaging the display surface.
- (5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.
- (6) Avoid contacting oil and fats.
- (7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.
- (8) Do not put or attach anything on the display area to avoid leaving marks on.
- (9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).
- (10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

13-2. Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

- (1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



- (2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ± 0.1 mm.

13-3. Precaution for Handling LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- (1) Do not alter, modify or change the shape of the tab on the metal frame.
- (2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- (3) Do not damage or modify the pattern writing on the printed circuit board.

- (4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- (5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- (6) Do not drop, bend or twist LCM.

LCM is easy to be damaged. Please note below and be careful for handling.

Correct handling:

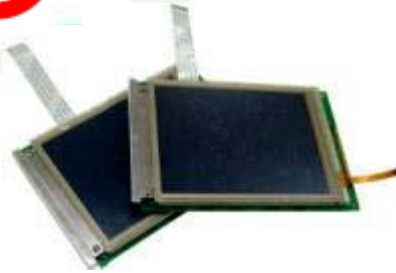


As above picture, please handle with anti-static gloves around LCM edges.

Incorrect handling:



Please don't touch IC directly.



Please don't stack LCM.



Please don't hold the surface of panel.



Please don't stretch interface of output, such as FPC cable.



Please don't hold the surface of IC.

Please don't operate with sharp stick such as pens.

13-4. Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

- (1) Make certain that you are grounded when handing LCM.
- (2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
- (3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
- (4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
- (5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
- (6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

13-5. Precaution for soldering to the LCM

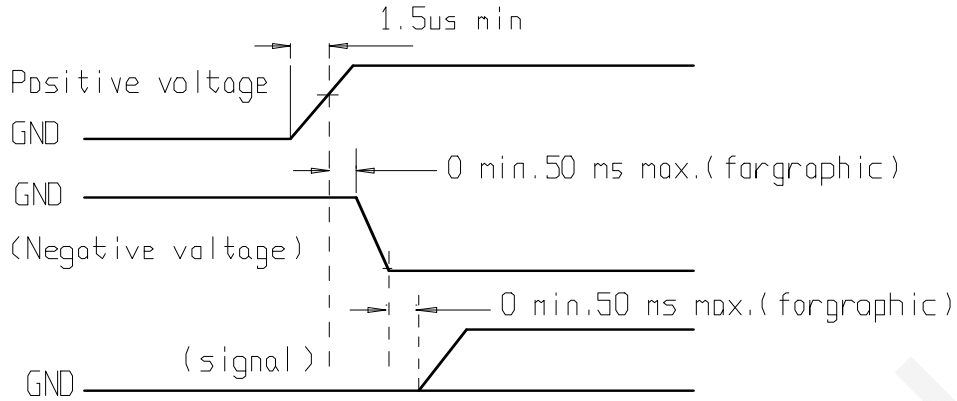
- (1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
 - Soldering iron temperature : $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$.
 - Soldering time : 3-4 sec.
 - Solder : eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

- (2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
- (3) When remove the electoluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

13-6. Precautions for Operation

- (1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.
- (2) Driving the LCD in the voltage above the limit shortens its life.
- (3) Response time is greatly delayed at temperature below the 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.
- (4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
- (5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40°C , 50% RH.
- (6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



13-7. Storage

When storing LCDs as spares for some years, the following precaution are necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

(4) Environmental conditions :

- Do not leave them for more than 168hrs. at 60°C.
- Should not be left for more than 48hrs. at -20°C.

13-8. Safety

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

13-9. Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- soldering to or modifying the bezel in any manner.

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 eyelet's, conductors and terminals.