LCD Module

Product Specification

□ : **APPROVAL FOR SPECIFICATION**

For Customer：_____ □ : **APPROVAL FOR SAMPLE**

Module No.： TSM160160C

For Customer's Acceptance ：

Approved by	**Comment**

Team Source Display ：

Presented by	**Reviewed by**	**Organized by**

Table of Content

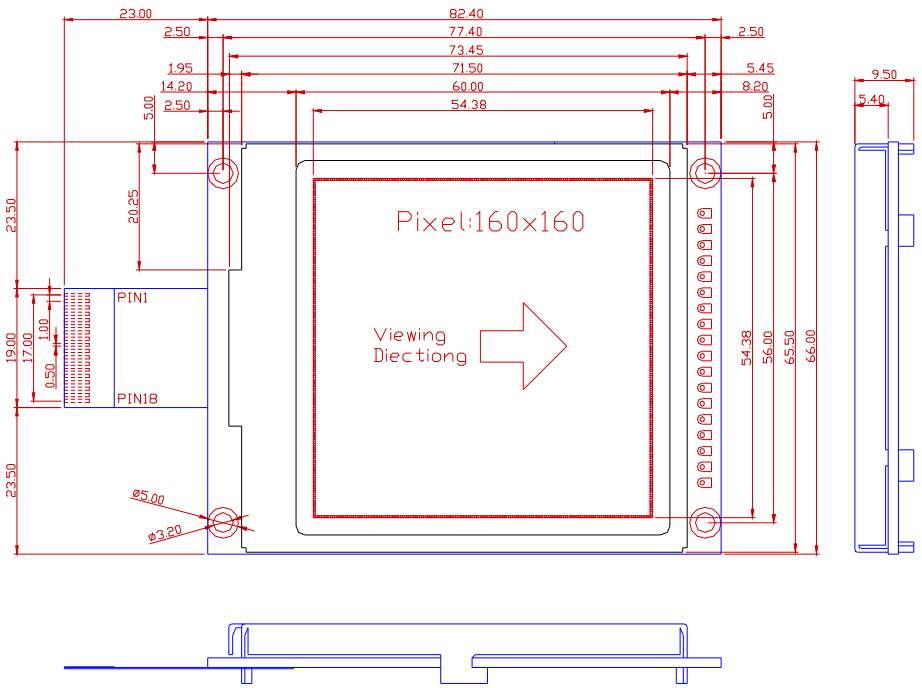
1. Bsaic Specifications

1.1 Display Specifications

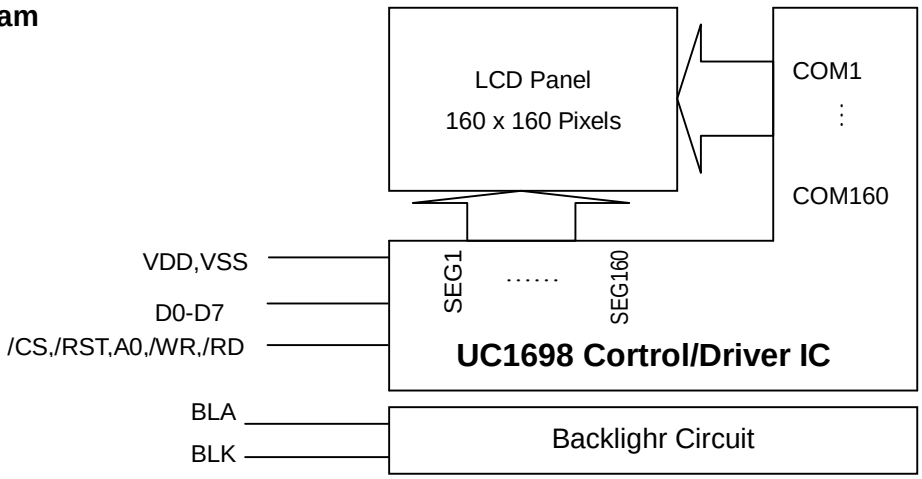
1>LCD Display Mode : FSTN, Positive, Transflective
2>Viewing Angle : 9H
3>Driving Method : 1/160 Duty, 1/10 Bias
4>Backlight : White LED (4PCS)

1.2 Mechanical Specifications

1>Outline Dimension : 82.4 x 66.0 x 9.5mm (See attached Outline Drawing for Details)



1.3 Circuit Diagram



1.4 Terminal Function

Pin No.	Pin Name	Function
1	VSS	Negative power supply,0V
2	A0	Data/Command control
3	/WR	Write Data/Command Clock
4	/RD	Read Data Clock
5	/CS	Chip selection input
6	/RST	Reste, L->H
7	VDD	Power supply voltage (+3.3V)
8-15	D0-D7	Data Bus
16	BLK	Backlight Power Supply Negative
17	NC	
18	BLA	Backlight Power Supply anode (+3.3V)

2. Absolute Maximum Ratings

Items	Symbol	MIN.	MAX.	Unit	Condition
Supply Voltage	V_{DD}	-0.3	+4.0	V	V_{SS} = 0V
	V_{DD2}	-0.3	+4.0	V	V_{SS} = 0V
Input Voltage	V_{IN}	-0.3	V_{DD}+0.3	V	V_{SS} = 0V
Operating Temperature	T_{OP}	-20	+70	℃	No Condensation
Storage Temperature	Tst	-30	+80	℃	No Condensation

3. Electrical Characteristics

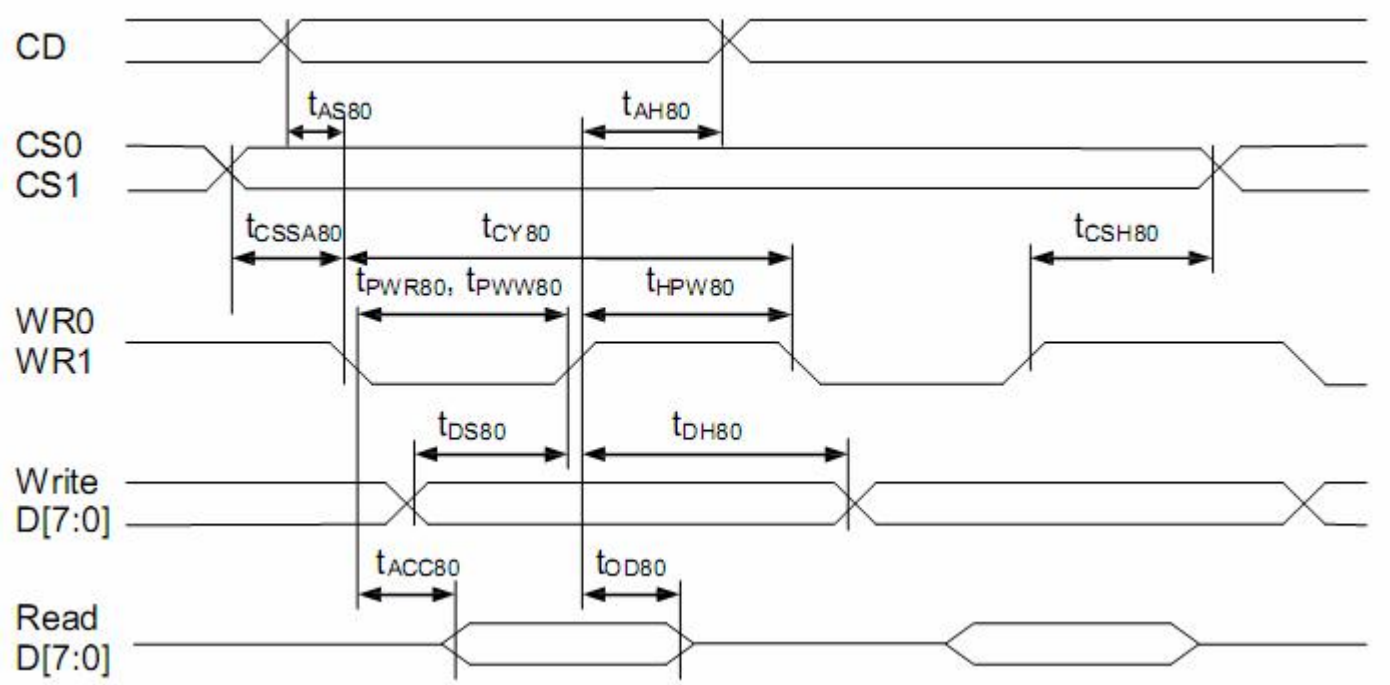
3.1 DC Characteristics

(V_{SS} = 0V, V_{DD} = 2.4 to 3.6V, Ta = -40~85°C)

Items	Symbol	MIN.	TYP.	MAX.	Unit	Condition
Operating Voltage(1)	V_{DD}	2.4	-	3.6	V	
Driver Voltage	VLCD	-0.3	-	19.0	V	
Input High Voltage	V_{IH}	0.8 x V_{DD}	-	V_{DD}	V	
Input Low Voltage	V_{IL}	V_{SS}	-	0.2 x V_{DD}	V	
Output High Voltage	V_{OH}	0.8 x V_{DD}	-	V_{DD}	V	I_{OH} = -0.5mA
Output Low Voltage	V_{OL}	V_{SS}	-	0.2 x V_{DD}	V	I_{OL} = 0.5mA
Input Leakage Current	I_{LI}	-	-	1.5	μA	V_{IN} = V_{DD} or V_{SS}

3.2 AC Characteristics

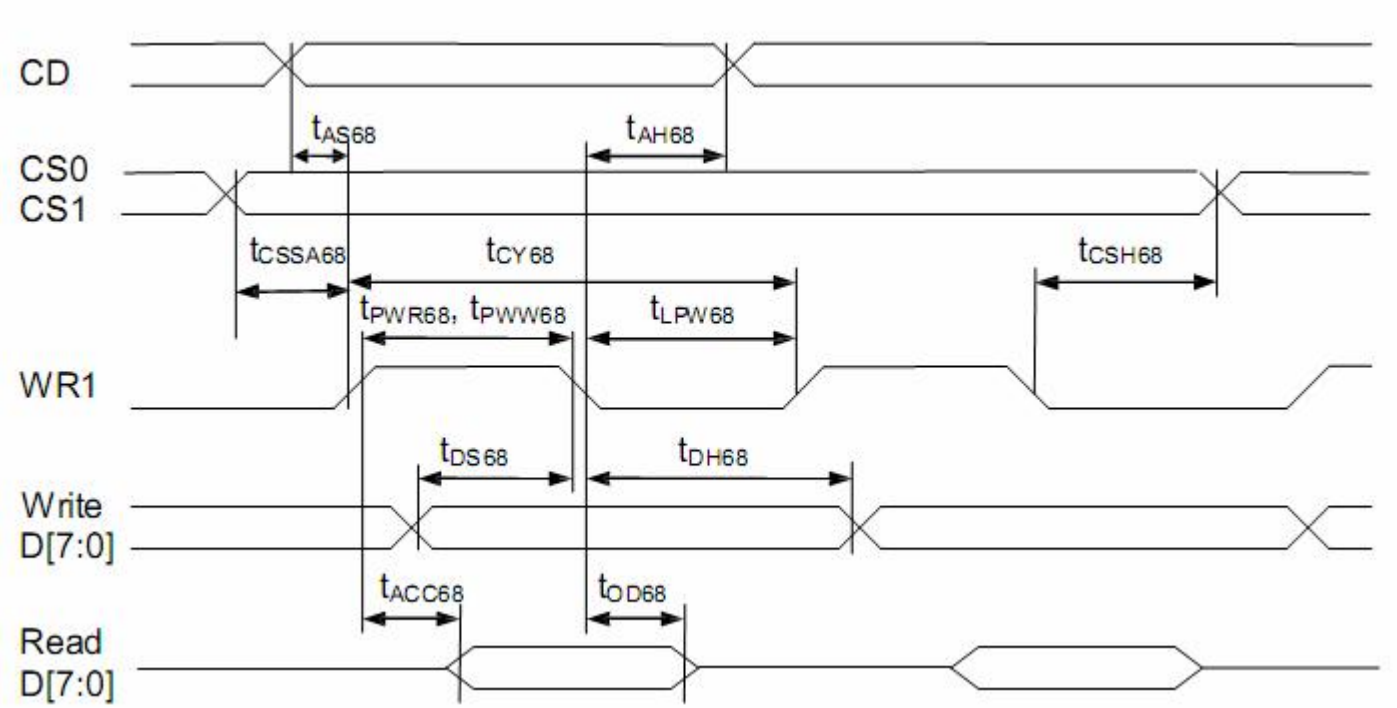
Read/Write Characteristics (8080-series MPU)



(2.5V ≤ V_{DD} < 3.3V, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS80} t_{AH80}	CD	Address setup time Address hold time		0 0	–	nS
t_{CY80}		System cycle time 16-bit bus (read) (write) 8-bit bus (read) (write)		 170 130 100 80	–	nS
t_{PWR80}	WR1	Pulse width 16-bit (read) 8-bit		85 50	–	nS
t_{PWW80}	WR0	Pulse width 16-bit (write) 8-bit		65 40	–	nS
t_{HPW80}	WR0, WR1	High pulse width 16-bit bus (read) (write) 8-bit bus (read) (write)		 85 65 50 40	–	nS
t_{DS80} t_{DH80}	D0~D15	Data setup time Data hold time		30 0	–	nS
t_{ACC80} t_{OD80}		Read access time Output disable time	C_L = 100pF	– 15	60 30	nS
T_{CSSA80} t_{CSH80}	CS1/CS0	Chip select setup time		5 5		nS

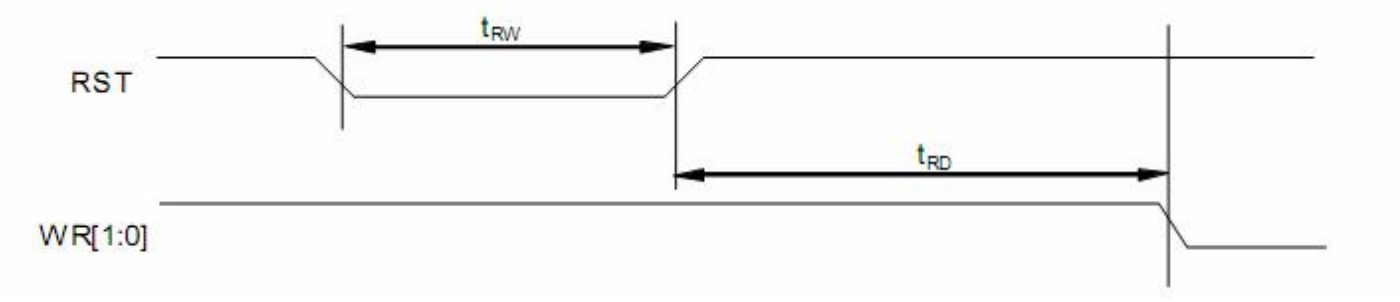
Read/Write Characteristics (6800-series MPU)



(2.5V ≤ V_{DD} < 3.3V, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{AS68} t_{AH68}	CD	Address setup time Address hold time		0 0	–	nS
t_{CY68}		System cycle time 16-bit bus (read) (write) 8-bit bus (read) (write)		 170 130 100 80	–	nS
t_{PWR68}	WR1	Pulse width 16-bit (read) 8-bit		85 50	–	nS
t_{PWW68}		Pulse width 16-bit (write) 8-bit		65 40	–	nS
t_{LPW68}		Low pulse width 16-bit bus (read) (write) 8-bit bus (read) (write)		 85 65 50 40	–	nS
t_{DS68} t_{DH68}	D0~D7	Data setup time Data hold time		30 0	–	nS
t_{ACC68} t_{OD68}		Read access time Output disable time	C_L = 100pF	– 15	60 30	nS
t_{CSSA68} t_{CSH68}	CS1/CS0	Chip select setup time		5 5		nS

3.3 Resret Timing



(1.65V U V_{DD}< 3.3V, Ta= –30 to +85°C)

Symbol	Signal	Description	Condition	Min.	Max.	Units
t_{RW}	RST	Reset low pulse width		3	–	µS
t_{RD}	RST, WR	Reset to WR pulse delay		10	–	mS

4. Function specifications

4.1 Display data format

16 bits of input data are stored to 16 RAM bits directly.

Data Write Sequence (8-bit)	*D[7:0]*							
1st Write Data Cycle	R4	R3	R2	R1	R0	G5	G4	G3
2nd Write Data Cycle	G2	G1	G0	B4	B3	B2	B1	B0

For Example

Black and white mode:

RGB=SEG1/SEG2/SEG3.

R[4:0]= Fixed Value[0x1F] ->SEG1 Show,

G[5:0]= Fixed Value[0x3F] ->SEG2 Show,

B[4:0]= Fixed Value[0x1F] ->SEG3 Show,

Grayscale mode:

R[4:0]= Range[0-31] ->SEG1 Show,

G[5:0]= Range[0-63] ->SEG2 Show,

B[4:0]= Range[0-31] ->SEG3 Show,

Note:Write three points must be continuous,SEG1/SEG2/SEG3 Share a single address

(注：必须连续写三个点,因为三点共用一个地址,根据设置,写完后,地址会自动加（减）一)

4.2 Resetting the LCD module

The LCD module should be initialized bu using /RES terminal.

While turning on the VDD and VSS power supply, maintain /RES terminal at LOW level, After the Power supply stabilized, release the reset terminal(/RES = High)

4.3 Commands Table

The following is a list of host commands supported by UC1698u

C/D: 0: Control, 1: Data W/R: 0: Write Cycle, 1: Read Cycle

#: Useful Data bits –: Don't Care

	Command	C/D	W/R	D7	D6	D5	D4	D3	D2	D1	D0	Action	Default
1	Write Data Byte	1	0	#	#	#	#	#	#	#	#	Write 1 byte	N/A
2	Read Data Byte	1	1	#	#	#	#	#	#	#	#	Read 1 byte	N/A
3	Get Status & PM	0	1	GE	MX	MY	WA	DE	WS	MD	MS	Get {Status, Ver, PMO, Product Code, PID, MID}	N/A
				Ver	PMO[6:0]								
				Product Code (8h)				PID[1:0]		MID[1:0]			
4	Set Column Address LSB	0	0	0	0	0	0	#	#	#	#	Set CA[3:0]	0
	Set Column Address MSB	0	0	0	0	0	1	0	#	#	#	Set CA[6:4]	0
5	Set Temp. Compensation	0	0	0	0	1	0	0	1	#	#	Set TC[1:0]	0
6	Set Power Control	0	0	0	0	1	0	1	0	#	#	Set PC[1:0]	10b
7	Set Adv. Program Control	0	0	0	0	1	1	0	0	0	R	Set APC[R][7:0], R = 0 or 1	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
8	Set Scroll Line LSB	0	0	0	1	0	0	#	#	#	#	Set SL[3:0]	0
	Set Scroll Line MSB	0	0	0	1	0	1	#	#	#	#	Set SL[7:4]	0
9	Set Row Address LSB	0	0	0	1	1	0	#	#	#	#	Set RA[3:0]	0
	Set Row Address MSB	0	0	0	1	1	1	#	#	#	#	Set RA[7:4]	0
10	Set V_{BIAS} Potentiometer	0	0	1	0	0	0	0	0	0	1	Set PM[7:0]	40H
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
11	Set Partial Display Control	0	0	1	0	0	0	0	1	0	#	Set LC[8]	0
12	Set RAM Address Control	0	0	1	0	0	0	1	#	#	#	Set AC[2:0]	001b
13	Set Fixed Lines	0	0	1	0	0	1	0	0	0	0	Set {FLT,FLB}	0
		0	0	#	#	#	#	#	#	#	#		
14	Set Line Rate	0	0	1	0	1	0	0	0	#	#	Set LC[4:3]	10b
15	Set All-Pixel-ON	0	0	1	0	1	0	0	1	0	#	Set DC[1]	0
16	Set Inverse Display	0	0	1	0	1	0	0	1	1	#	Set DC[0]	0
17	Set Display Enable	0	0	1	0	1	0	1	#	#	#	Set DC[4:2]	110b
18	Set LCD Mapping Control	0	0	1	1	0	0	0	#	#	#	Set LC[2:0]	0
19	Set N-Line Inversion	0	0	1	1	0	0	1	0	0	0	Set NIV[4:0]	1DH
				-	-	-	#	#	#	#	#		
20	Set Color Pattern	0	0	1	1	0	1	0	0	0	#	Set LC[5]	0 (BGR)
21	Set Color Mode	0	0	1	1	0	1	0	1	#	#	Set LC[7:6]	10b
22	Set COM Scan Function	0	0	1	1	0	1	1	#	#	#	Set CSF[2:0]	000b
23	System Reset	0	0	1	1	1	0	0	0	1	0	System Reset	N/A
24	NOP	0	0	1	1	1	0	0	0	1	1	No operation	N/A

25	Set Test Control	0	0	1	1	1	0	0	1	TT		For testing only. Do not use.	N/A
	(double-byte command)	0	0	#	#	#	#	#	#	#	#		
26	Set LCD Bias Ratio	0	0	1	1	1	0	1	0	#	#	Set BR[1:0]	11b: 12
27	Set COM End	0	0	1	1	1	1	0	0	0	1	Set CEN[6:0]	159
		0	0	-	#	#	#	#	#	#	#		
28	Set Partial Display Start	0	0	1	1	1	1	0	0	1	0	Set DST[6:0]	0
		0	0	-	#	#	#	#	#	#	#		
29	Set Partial Display End	0	0	1	1	1	1	0	0	1	1	Set DEN[6:0]	159
		0	0	-	#	#	#	#	#	#	#		
30	Set Window Program Starting Column Address	0	0	1	1	1	1	0	1	0	0	Shared with MTP commands	Set WPC0	0
		0	0	-	#	#	#	#	#	#	#		
31	Set Window Program Starting Row Address	0	0	1	1	1	1	0	1	0	1		Set WPP0	0
		0	0	#	#	#	#	#	#	#	#		
32	Set Window Program Ending Column Address	0	0	1	1	1	1	0	1	1	0		Set WPC1	127
		0	0	-	#	#	#	#	#	#	#		
33	Set Window Program Ending Row Address	0	0	1	1	1	1	0	1	1	1		Set WPP1	159
		0	0	#	#	#	#	#	#	#	#		
34	Window Program Mode	0	0	1	1	1	1	1	0	0	#	Set AC[3]		0: Inside
35	Set MTP Operation control	0	0	1	0	1	1	1	0	0	0	Set MTPC[4:0]		10H
		0	0	-	-	-	#	#	#	#	#		

LCD Display Memory Mapping (显示屏与显存的映射关系)

Row Adderss	RAM	MY=0 SL=0	MY=0 SL=16	MY=1 SL=0	MY=1 SL=16
00H		COM1	COM17	COM160	COM16
01H		COM2	COM18	COM159	COM15
02H		COM3	COM19	COM158	COM14
03H		COM4	COM20	COM157	COM13
04H		COM5	COM21	COM156	COM12
05H		COM6	COM22	COM155	COM11
06H		COM7	COM23	COM154	COM10
07H		COM8	COM24	COM153	COM9
08H		COM9	COM25	COM152	COM8
09H		COM10	COM26	COM151	COM7
0AH		COM11	COM27	COM150	COM6
0BH		COM12	COM28	COM149	COM5
0CH		COM13	COM29	COM148	COM4
0DH		COM14	COM30	COM147	COM3
0EH		COM15	COM31	COM146	COM2
0FH		COM16	COM32	COM145	COM1
10H		COM17	COM33	COM144	COM160
11H		COM18	COM34	COM143	COM159
12H		COM19	COM35	COM142	COM158
13H		COM20	COM36	COM141	COM157
14H		COM21	COM37	COM140	COM156
15H		COM22	COM38	COM139	COM155
16H		COM23	COM39	COM138	COM154
17H		COM24	COM40	COM137	COM153
18H		COM25	COM41	COM136	COM152
19H		COM26	COM42	COM135	COM151
1AH		COM27	COM43	COM134	COM150
1BH		COM28	COM44	COM133	COM149
1CH		COM29	COM45	COM132	COM148
88H		COM137	COM153	COM24	COM40
89H		COM138	COM154	COM23	COM39
8AH		COM139	COM155	COM22	COM38
8BH		COM140	COM156	COM21	COM37
8CH		COM141	COM157	COM20	COM36
8DH		COM142	COM158	COM19	COM35
8EH		COM143	COM159	COM18	COM34
8FH		COM144	COM160	COM17	COM33
90H		COM145	COM1	COM16	COM32
91H		COM146	COM2	COM15	COM31
92H		COM147	COM3	COM14	COM30
93H		COM148	COM4	COM13	COM29
94H		COM149	COM5	COM12	COM28
95H		COM150	COM6	COM11	COM27
96H		COM151	COM7	COM10	COM26
97H		COM152	COM8	COM9	COM25
98H		COM153	COM9	COM8	COM24
99H		COM154	COM10	COM7	COM23
9AH		COM155	COM11	COM6	COM22
9BH		COM156	COM12	COM5	COM21
9CH		COM157	COM13	COM4	COM20
9DH		COM158	COM14	COM3	COM19
9EH		COM159	COM15	COM2	COM18
9FH		COM160	COM16	COM1	COM17

MX	SEG1	SEG2	SEG3	SEG4	SEG5			SEG380	SEG381	SEG382	SEG383	SEG384
0	SEG382	SEG383	SEG384	SEG379	SEG380			SEG5	SEG6	SEG1	SEG2	SEG3
1												

4.4 Basic Operating Sequence

Initialization Sequence

```
void intial(void)
{
 RES=0;
 delay(500);
 RES=1;
 delay(200);
 Comwrite(0xe2);//soft rest
 Comwrite(0x2b);//set power control
 Comwrite(0x81);//set Vbias
 Comwrite(250); //0-255
 Comwrite(0x8d);//set RAM address control

 Comwrite(0xea);
 //set lcd bais ratio    1/12 22page

 //- - - - - MY MX LCO
 Comwrite(0xc0);//set LCD Mapping Control
 Comwrite(0xa3);//set line rate

 Comwrite(0xD1);
 //Set Color Pattern 0xD0(BGR) 0xD1(RGB)

 Comwrite(0xD6);
 //set color mode DC[4]=1;RGB=565

 Comwrite(0xD8);//set com scan function 22page

 Comwrite(0x00);
 Comwrite(0x10);
 Comwrite(0x60);
 Comwrite(0x70);

 Comwrite(0xf1);
 Comwrite(159);//set com end 0-0x7f
 Comwrite(0xF8);//set window progran mode or f9
 Comwrite(0xaf);//set Display Enable
 delay(10);
}
```

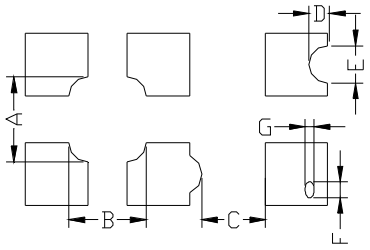
```
void Setadd(uchar xs,ys,uchar xd,yd)
{     uchar j;
       Comwrite(0xf4);//set start column address
       Comwrite(xs);//0-7f
       Comwrite(0xF6);//set end column address
       Comwrite(xd);//0-7f

       Comwrite(0xF5);//set start row address
       Comwrite(ys);//0-ff
       Comwrite(0xF7);//set end row address
       Comwrite(yd);//0-ff
     j=xs;
     Comwrite(j&0x0f);
     j>>=4;
     Comwrite(0x10+j);
     j=yd&0x0f;
     Comwrite(0x60+j);
     j=yd>>4;
     Comwrite(0x70+j);
}

void Clear(uchar dat)
{
   uchar i;
   uint    j;
   Setadd(37,0,90,159);
   for(i=0;i<160;i++)
   for(j=0;j<110;j++)
         Datwrite(dat);
}
```

Specific application, refer to IC data and Programm

5. Inspection Standards

Item	Criterion for defects	Defect type
1) Display on inspection	(1) Non display (2) Vertical line is deficient (3) Horizontal line is deficient (4) Cross line is deficient	Major
2) Black / White spot	Size Φ(mm) Acceptable number Φ≤0.3 Ignore (note) 0.3<Φ≤0.45 3 0.45<Φ≤0.6 1 0.6<Φ 0	Minor
3) Black / White line	Length (mm) Width (mm) Acceptable number L≤10 W≤0.03 Ignore 5.0≤L≤10 0.03<W≤0.04 3 5.0≤L≤10 0.04<W≤0.05 2 1.0≤L≤10 0.05<W≤0.06 2 1.0≤L≤10 0.06<W≤0.08 1 L≤10 0.08<W follows 2) point defect Defects separate with each other at an interval of more than 20mm	Minor
4) Display pattern	 $\frac{A+B}{2} \leq 0.28$ 0<C $\frac{D+E}{2} \leq 0.25$ $\frac{F+G}{2} \leq 0.25$ Note: 1) Up to 3 damages acceptable 2) Not allowed if there are two or more pinholes every three-fourth inch.	Minor
5) Spot-like contrast irregularity	Size Φ(mm) Acceptable Number Φ≤0.7 Ignore (note) 0.7<Φ≤1.0 3 1.0<Φ≤1.5 1 1.5<Φ 0 Note: 1) Conformed to limit samples. 2) Intervals of defects are more than 30mm.	Minor
6) Bubbles in polarizer	Size Φ(mm) Acceptable Number Φ≤0.4 Ignore (note) 0.4<Φ≤0.65 2 0.65<Φ≤1.2 1 1.2<Φ 0	Minor
7) Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with "2) Black/white spot", and "3) Black/White line".	Minor
8) Stains on the surface of LCD panel	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning.	Minor
9) Rainbow color	No rainbow color is allowed in the optimum contrast on state within the active area.	Minor
10) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.	Minor
11) Bezel appearance	Rust and deep damages that are visible in the bezel are rejected.	Minor
12) Defect of land surface contact	Evident crevices that are visible are rejected.	Minor
13) Parts mounting	(1) Failure to mount parts (2) Parts not in the specifications are mounted (3) For example: Polarity is reversed, HSC or TCP falls off.	Minor
14) Part alignment	(1) LSI, IC lead width is more than 50% beyond pad outline. (2) More than 50% of LSI, IC leads is off the pad outline.	Minor
15) Conductive foreign matter (solder ball, solder hips)	(1) 0.45<Φ, N≥1 (2) 0.3<Φ≤0.45, N≥1, Φ: Average diameter of solder ball (unit: mm) (3) 0.5<L, N≥1, L: Average length of solder chip (unit: mm)	Minor
16) Bezel flaw	Bezel claw missing or not bent	Minor
17) Indication on name plate (sampling indication label)	(1) Failure to stamp or label error, or not legible.(all acceptable if legible) (2) The separation is more than 1/3 for indication discoloration, in which the characters can be checked.	Minor

6. Handling Precautions

6.1 Mounting method

A panel of LCD module made by our company consists of two thin glass plates with polarizers that easily get damaged.

And since the module in so constructed as to be fixed by utilizing fitting holes in the printed circuit board (PCB), extreme care should be used when handling the LCD modules.

6.2 Cautions of LCD handling and cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

-Isopropyl alcohol

-Ethyl alcohol

-Trichlorotriflorothane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

-Water

-Ketene

-Aromatics

6.3 Caution against static charge

The LCD module use C-MOS LSI drivers. So we recommend you:

Connect any unused input terminal to V_{dd} or V_{ss}. Do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

6.4 Packaging

-Module employs LCD elements, and must be treated as such. Avoid intense shock and falls from a height.

-To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

6.5 Caution for operation

-It is an indispensable condition to drive LCD module within the limits of the specified voltage since the higher voltage over the limits may cause the shorter life of LCD module.

-An electrochemical reaction due to DC (direct current) causes LCD undesirable deterioration so that the uses of DC (direct current) drive should be avoided.

-Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD module may show dark color in them. However those phenomena do not mean malfunction or out of order of LCD module, which will come back in the specified operating temperature.

6.6 Storage

In the case of storing for a long period of time, the following ways are recommended:

-Storage in polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with not desiccant.

-Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping the storage temperature range.

-Storing with no touch on polarizer surface by any thing else.

6.7 Safety

-It is recommendable to crash damaged or unnecessary LCD into pieces and to wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.

-When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well at once with soap and water.