



# **TM57 Series**

TM57FLA80 DEMO CODE  
FOR LCD FUNCTION

## **Application Note**

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**PRODUCT NAME**

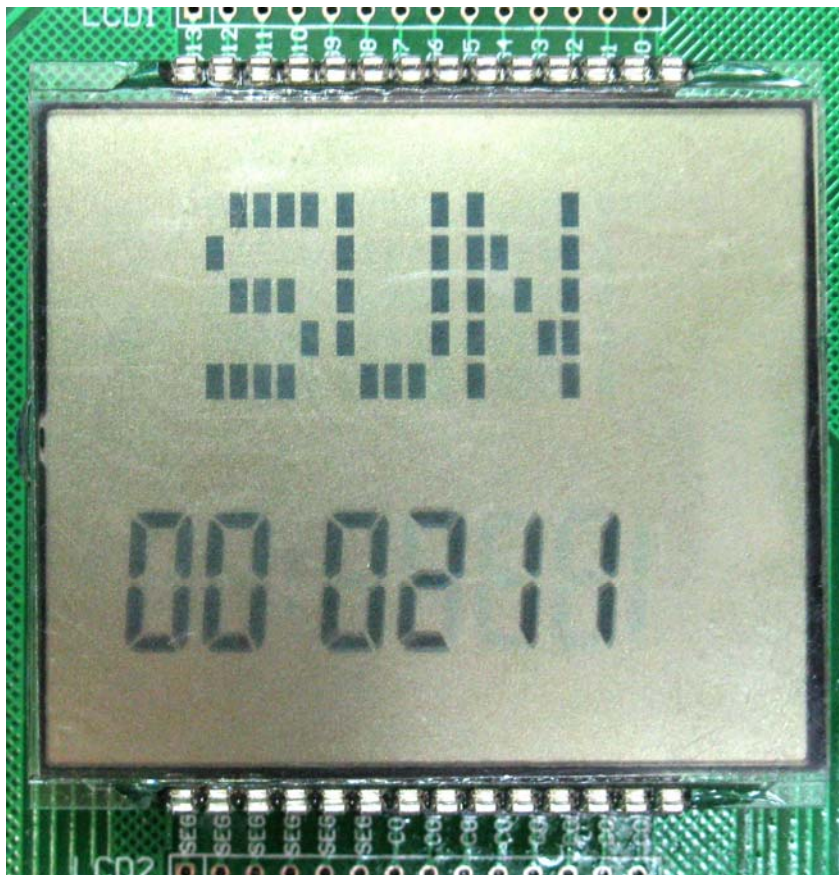
TM57 Series IC

**TITLE**

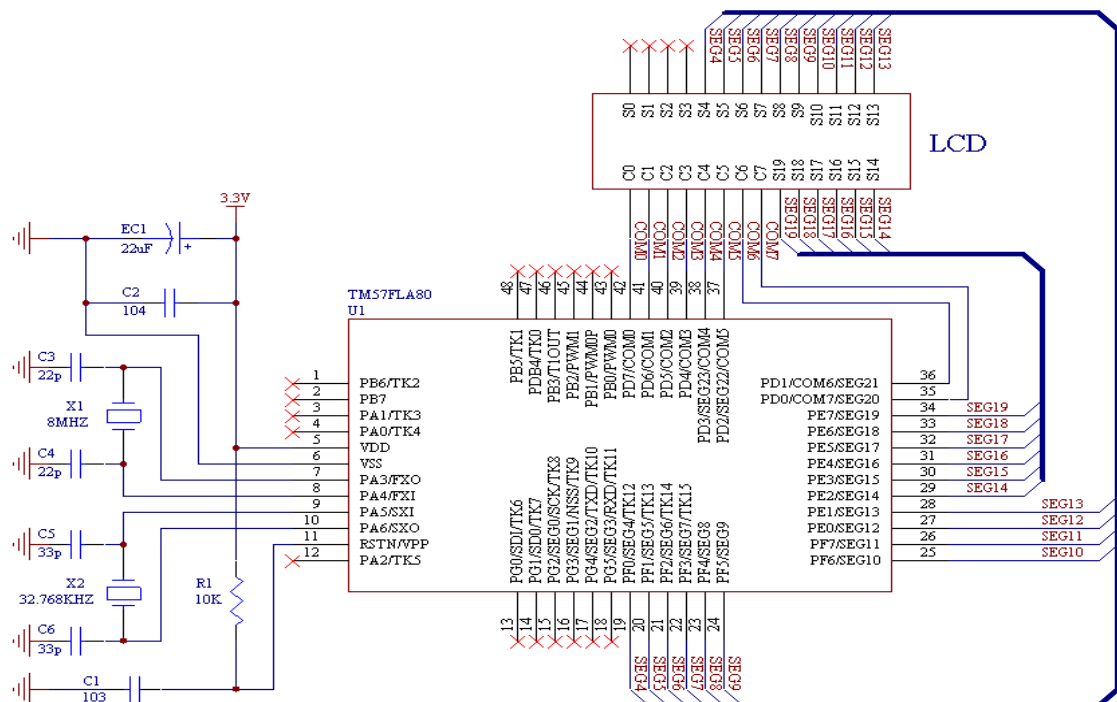
TM57FLA80 DEMO CODE FOR LCD FUNCTION

**APPLICATION NOTE****01. Introduction to DEMO functions**

1. To get the detail of the DEMO program, please refer to TM57FLA80\_LCD.ASM
2. Illustration to DEMO functions ( as shown in the following pictures )
  - 1) Display “**SUN**” letters.
  - 2) Display the time under “**SUN**” letters, which includes Hours(00~23), Minutes(00~59), Seconds(00~59). The displayed data will change with time. The LCD parameters used are 1/8 Duty ,1/3 Bias, the working voltage is 3.0V



### 3. Circuit Diagram



## 02. LCD initialization set up method

### 1. Set up the base LCD driving clock

The base LCD driving clock is related to TM2. The user can set it up in the TM2CTRL register. The address of TM2CTRL is R PLANE 0DH.

First, select the clock source of TM2. If BIT4 of TM2CTRL is set to 1, the clock source of TM2 will be Fosc/128 (Fosc is the system clock); otherwise, if it is zero, the clock source will be the system sub-clock.

Then, select the LCD alternative frequency (setting LCDCLK register). There are 4 possible selections, which are controlled by the two bits, BIT[1:0], of TM2CTRL:

BIT[1:0]=00	LCDCLK=128,	LCD alternative freq=system sub-clock/128
BIT[1:0]=01	LCDCLK=64,	LCD alternative freq=system sub-clock/64
BIT[1:0]=10	LCDCLK=32,	LCD alternative freq=system sub-clock/32
BIT[1:0]=11	LCDCLK=16,	LCD alternative freq=system sub-clock/16

For example, let us assume the clock source of TM2 is the system sub-clock and the frequency of the system sub-clock is 32.768Hz, the DUTY of LCD is 1/8, the target LCD frame frequency is 32Hz, i.e. the time to scan LCD for one cycle is 31.25ms. According to formula:

(the time to scan LCD for one cycle) =  $2 \times [ (1 / \text{frequency of the system sub-clock}) \times (\text{LCDCLK}) ] \div (\text{DUTY of LCD})$

We get:

$$\begin{aligned}
 (\text{LCDCLK}) &= (\text{the time to scan LCD for one cycle}) \\
 &\quad \times (\text{DUTY of LCD}) \times (\text{frequency of the system sub-clock}) \div 2 \\
 &= (31.25 \times 0.001) \times (1/8) \times (32.768 \times 1000) \div 2 \\
 &= 64
 \end{aligned}$$

Then, BIT[1:0] of TM2CTRL = 01. The instructions to execute are as follows:

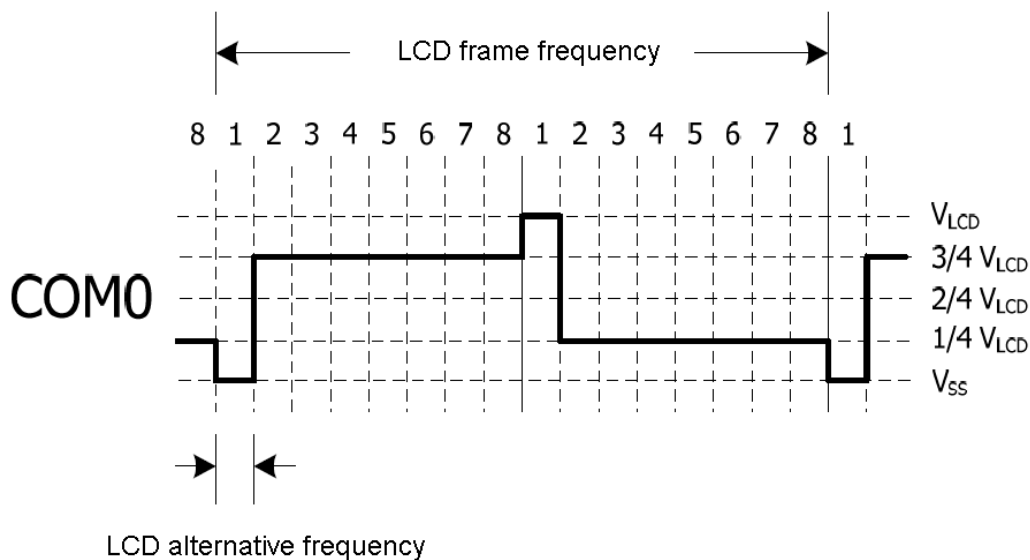
```

movlw    TIMER2CLK_subClock    ;b' 00000000'
iorlw    LCDCLK_64              ;b' 00000001'
movwrr   TM2CTRL

```

The following is the waveform of the COM0 port. The Frame time in Figure 1 is the time to scan LCD for one cycle, i.e. 31.25ms. The time of each grid represents the base LCD driving clock, i.e.

$$\begin{aligned}
 & (1 / \text{frequency of the system sub-clock}) \times ((\text{LCDCLK})) \\
 &= 1.953125 \text{ ms}
 \end{aligned}$$



**2. Select appropriate COM and SEG ports**

The selection of COM and SEG ports is related to the three bits, BIT[6:4], of the LCD\_PU register(R PLANE 0Ah). The user can set the corresponding parameters based on the following table.

BIT[6:4]=000	LCDpin_use_NO	;b'00000000'
BIT[6:4]=001	LCDpin_use_com[0~3]andseg[20~23]	;b'00010000'
BIT[6:4]=010	LCDpin_use_com[0~7]andseg[16~19]	;b'00100000'
BIT[6:4]=011	LCDpin_use_com[0~7]andseg[12~19]	;b'00110000'
BIT[6:4]=100	LCDpin_use_com[0~7]andseg[8~19]	;b'01000000'
BIT[6:4]=101	LCDpin_use_com[0~7]andseg[4~19]	;b'01010000'
BIT[6:4]=110	LCDpin_use_com[0~7]andseg[2~19]	;b'01100000'
BIT[6:4]=111	LCDpin_use_com[0~7]andseg[0~19]	;b'01110000'

For example, we want to use COM0~COM7 and SEG4~SEG19. Because there is no need to use pull up, all the pull up resistors on the PD, PE, PF, PG ports for the corresponding COMs and SEGs will be forbidden. This way, we can execute the following instructions to achieve the effect:

```
movlw LCDpin_use_com[0~7]andseg[4~19] ;b'01010000'
iorlw PDU_Disable ;b'00000001'
iorlw PEPU_Disable ;b'00000010'
iorlw PFPU_Disable ;b'00000100'
iorlw PGPU_Disable ;b'00001000'
movwr LCD_PU
```

**3. Clear the LCD display RAM**

The addresses of LCD display RAM are in R-plane 20H~33H, a total of 20 registers. The purpose to clear these 20 registers is to set the LCD initialization state into all off mode. Please refer to the LCDINIT subroutine in the DEMO program for the instructions.

**4. Enable LCD and set appropriate DUTY, BIAS, and LCDBRIT**

This configuration is related to the LCDCTRL register at address, R-plane 11H. The following is the description for each bit of this register.

BIT[7] controls the ON/OFF of LCD:1=LCD ON, 0= OFF.

BIT[6:5] control the DUTY of LCD

BIT[6:5] =00      static

BIT[6:5] =01	1/3duty
BIT[6:5] =10	1/4duty
BIT[6:5] =11	1/8duty

BIT[4:3] control the BIAS of LCD:

BIT[4:3]=00	1/2bias
BIT[4:3]=01	1/3bias
BIT[4:3]=1x	1/4bias

BIT[2:0] control the LCDBRIT of LCD:

BIT[2:0] =000	LCDBrightness_(12Div20)VDD ;b'00000000'
BIT[2:0] =001	LCDBrightness_(12Div19)VDD ;b'00000001'
BIT[2:0] =010	LCDBrightness_(12Div18)VDD ;b'00000010'
BIT[2:0] =011	LCDBrightness_(12Div17)VDD ;b'00000011'
BIT[2:0] =100	LCDBrightness_(12Div15)VDD ;b'00000100'
BIT[2:0] =101	LCDBrightness_(12Div14)VDD ;b'00000101'
BIT[2:0] =110	LCDBrightness_(12Div13)VDD ;b'00000110'
BIT[2:0] =111	LCDBrightness_VDD ;b'00000111'

The user can select a corresponding value to fill the LCDCTRL register based on the specific requirement. For example, The instructions to set DUTY, BIAS, LCDBRIT of LCD to 1/8duty, 1/3bias, working voltage 3.0V((12/13)\*3.3) and enable LCD are as follows:

```
movlw    LCD_Enable           ; b'10000000'
iorlw    Duty_1Div8           ; b'01100000'
iorlw    Bais_1Div3           ; b'00001000'
iorlw    LCDBrightness_(12Div13)VDD ; b'00000110'
movwr    LCDCTRL
```

### 03. Configuration of the LCD display RAM

#### 1. The relationship between the Display RAM and the COMs and SEGs

8 COM	COM7	COM6	COM5	COM4	COM3	COM2	COM1	COM0
R-Plane 20	SEG0	SEG0	SEG0	SEG0	SEG0	SEG0	SEG0	SEG0
21	SEG1	SEG1	SEG1	SEG1	SEG1	SEG1	SEG1	SEG1
22	SEG2	SEG2	SEG2	SEG2	SEG2	SEG2	SEG2	SEG2
23	SEG3	SEG3	SEG3	SEG3	SEG3	SEG3	SEG3	SEG3
24	SEG4	SEG4	SEG4	SEG4	SEG4	SEG4	SEG4	SEG4
25	SEG5	SEG5	SEG5	SEG5	SEG5	SEG5	SEG5	SEG5
26	SEG6	SEG6	SEG6	SEG6	SEG6	SEG6	SEG6	SEG6
27	SEG7	SEG7	SEG7	SEG7	SEG7	SEG7	SEG7	SEG7
28	SEG8	SEG8	SEG8	SEG8	SEG8	SEG8	SEG8	SEG8
29	SEG9	SEG9	SEG9	SEG9	SEG9	SEG9	SEG9	SEG9
2a	SEG10	SEG10	SEG10	SEG10	SEG10	SEG10	SEG10	SEG10
2b	SEG11	SEG11	SEG11	SEG11	SEG11	SEG11	SEG11	SEG11
2c	SEG12	SEG12	SEG12	SEG12	SEG12	SEG12	SEG12	SEG12
2d	SEG13	SEG13	SEG13	SEG13	SEG13	SEG13	SEG13	SEG13
2e	SEG14	SEG14	SEG14	SEG14	SEG14	SEG14	SEG14	SEG14
2f	SEG15	SEG15	SEG15	SEG15	SEG15	SEG15	SEG15	SEG15
30	SEG16	SEG16	SEG16	SEG16	SEG16	SEG16	SEG16	SEG16
31	SEG17	SEG17	SEG17	SEG17	SEG17	SEG17	SEG17	SEG17
32	SEG18	SEG18	SEG18	SEG18	SEG18	SEG18	SEG18	SEG18
33	SEG19	SEG19	SEG19	SEG19	SEG19	SEG19	SEG19	SEG19

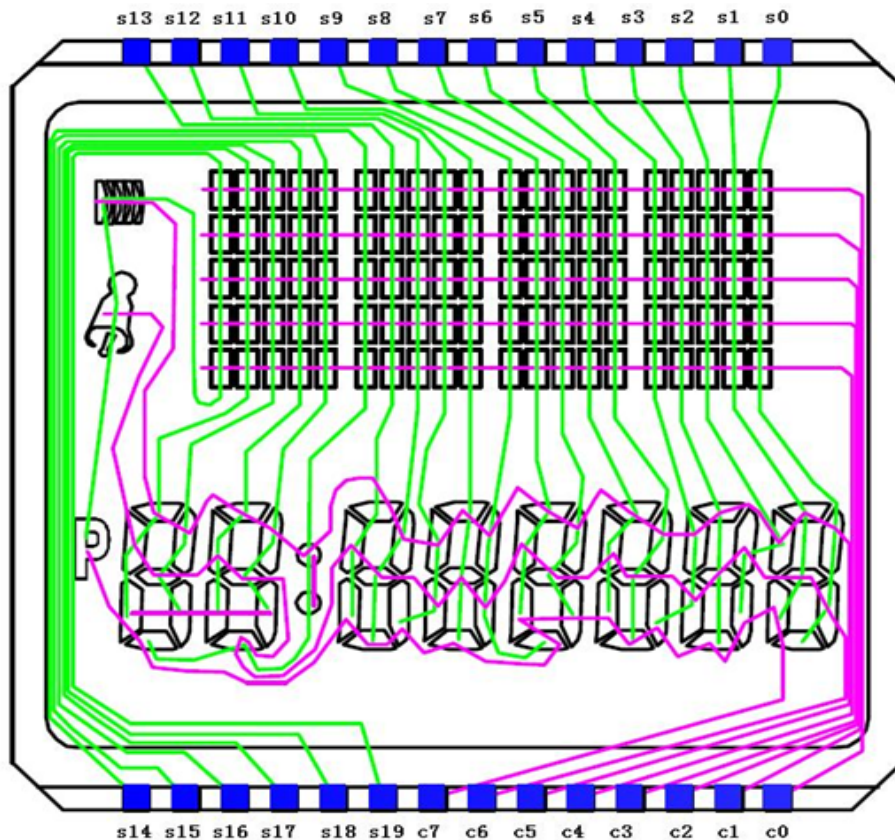
the relationship chart between the Display RAM and COM and SEG

The relationship between the Display RAM and the COMs and SEGs is shown in the chart above. For example, the register 20H in the chart controls SEG0 and the 8 bits of 20H, BIT7~BIT0, control COM7~COM0 respectively. i.e. in order to turn on the LCD pixel intersecting COM7 and SEG0 in the LCD panel diagram, set BIT7 of 20H to 1. Of course, if turning off is desired, clear the bit. Follow the same procedure to configure all other pixel.



## 2. Programming the LCD interface function

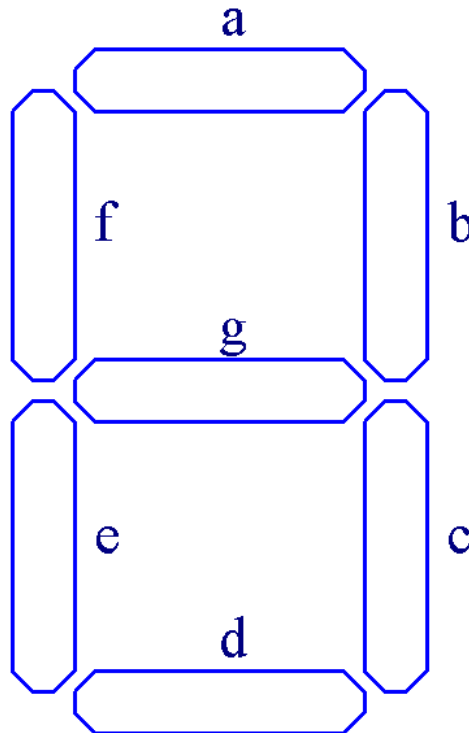
In order to facilitate programming, turning on LCD usually requires the composing of corresponding interface function based on the specified LCD panel diagram. Here, a LCD panel diagram as shown below will be used as an example to illustrate how to compose a subroutine for displaying letters using a 7 segment numeric code display. S in the panel diagram represents SEG(e.g. s0 represents SEG0), C represents COM(e.g. c0 represents COM0).



LCD panel Diagram

## 1) 7 segment numeric code display subroutine

A numeric code pattern is made of 7 segments, “a” “b” “c” “d” “e” “f” “g”. Therefore, it is called a 7 segment numeric code pattern. Their corresponding positions are shown in the following diagram:



There are 8 “7 segment numeric code patterns “ in the LCD panel diagram in total. Here, only the leftmost numeric code pattern will be illustrated; the others 7 can be deduced by the user following similar procedures.

First, arrange the positions of these 7 pixels. i.e. which intersection of SEG and COM correspond to these 7 pixels respectively. Then, mapping their corresponding address and bit in the Display RAM. The results are as follows:

point	intersection	RAM position
a	s18 and c5	BIT5 of 32H
b	s17 and c5	BIT5 of 31H
c	s17 and c7	BIT7 of 31H
d	s14 and c7	BIT7 of 2eH
e	s18 and c7	BIT7 of 32H
f	s18 and c6	BIT6 of 32H
g	s17 and c6	BIT6 of 31H

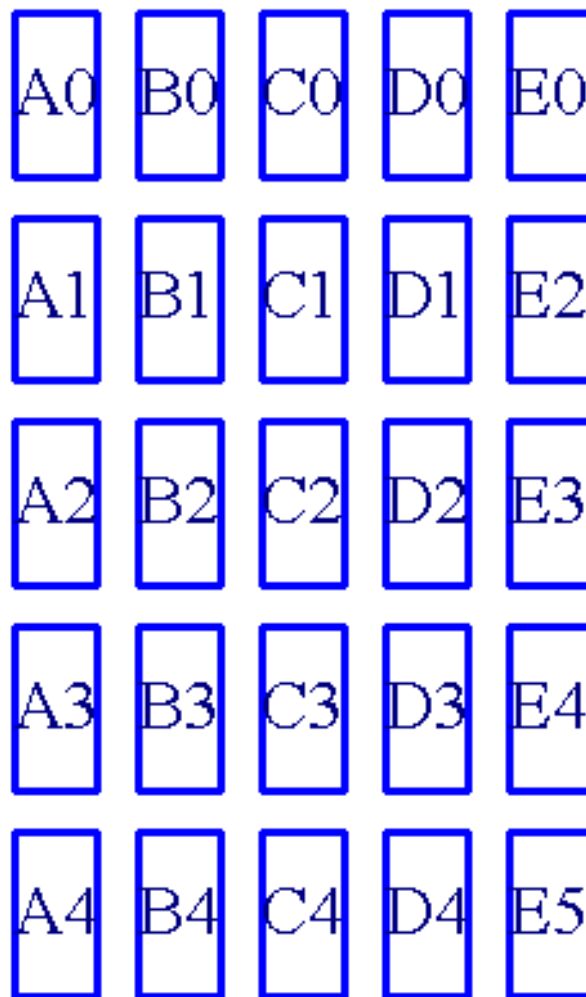
As such, when this 7 segment numeric code pattern is going to display 0,

abcdef should be turned on and g turned off. The following is the on/off states of a~g points when displaying 0:

a	s18 and c5	BIT5 of 32H =1
b	s17 and c5	BIT5 of 31H =1
c	s17 and c7	BIT7 of 31H =1
d	s14 and c7	BIT7 of 2eH =1
e	s18 and c7	BIT7 of 32H =1
f	s18 and c6	BIT6 of 32H =1
g	s17 and c6	BIT6 of 31H =0

Once these arrangement has done, programming becomes rather easy. As for the details of the program, please refer to the subroutine nSMG\_Dis\_1 in the DEMO program.

## 2) Dot Matrix LCD display subroutine

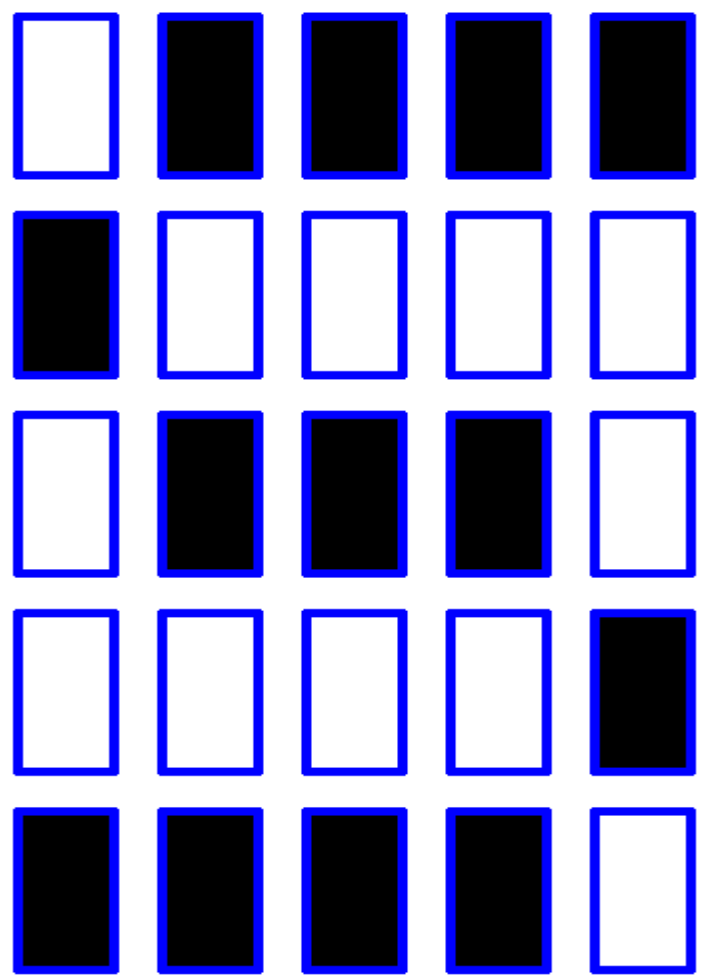


The above diagram is the mapping diagram corresponding to a 5×5 Dot

matrix. Here, we will use the leftmost matrix on the LCD panel diagram as an example to illustrate the programming procedure of the Dot Matrix LCD display subroutine.

Pixel	intersection	RAM position
A0	s19 and c0	BIT0 of 32H
A1	s19 and c1	BIT1 of 32H
A2	s19 and c0	BIT2 of 32H
A3	s19 and c3	BIT3 of 32H
A4	s19 and c4	BIT4 of 32H
B0	s18 and c0	BIT0 of 31H
B1	s18 and c1	BIT1 of 31H
B2	s18 and c0	BIT2 of 31H
B3	s18 and c3	BIT3 of 31H
B4	s18 and c4	BIT4 of 31H
C0	s17 and c0	BIT0 of 30H
C1	s17 and c1	BIT1 of 30H
C2	s17 and c0	BIT2 of 30H
C3	s17 and c3	BIT3 of 30H
C4	s17 and c4	BIT4 of 30H
D0	s16 and c0	BIT0 of 2fH
D1	s16 and c1	BIT1 of 2fH
D2	s16 and c0	BIT2 of 2fH
D3	s16 and c3	BIT3 of 2fH
D4	s16 and c4	BIT4 of 2fH
E0	s15 and c0	BIT0 of 2fH
E1	s15 and c1	BIT1 of 2fH
E2	s15 and c0	BIT2 of 2fH
E3	s15 and c3	BIT3 of 2fH
E4	s15 and c4	BIT4 of 2fH

Now, if we need to display a letter "s" on the dot-matrix, it will be shown as the diagram below :



Hence, the information of each pixel, A0~A4, B0~B4, C0~C4, D0~D4, E0~E4, are obtained as follows:

pixel	intersection	RAM address
A0	s19 and c0	BIT0 of 32H =1
A1	s19 and c1	BIT1 of 32H =0
A2	s19 and c0	BIT2 of 32H =0
A3	s19 and c3	BIT3 of 32H =1
A4	s19 and c4	BIT4 of 32H =0
B0	s18 and c0	BIT0 of 31H =1
B1	s18 and c1	BIT1 of 31H =0
B2	s18 and c0	BIT2 of 31H =1
B3	s18 and c3	BIT3 of 31H =0
B4	s18 and c4	BIT4 of 31H =1
C0	s17 and c0	BIT0 of 30H =1
C1	s17 and c1	BIT1 of 30H =0

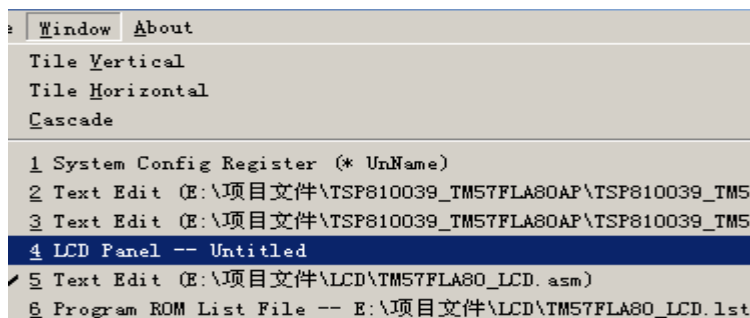
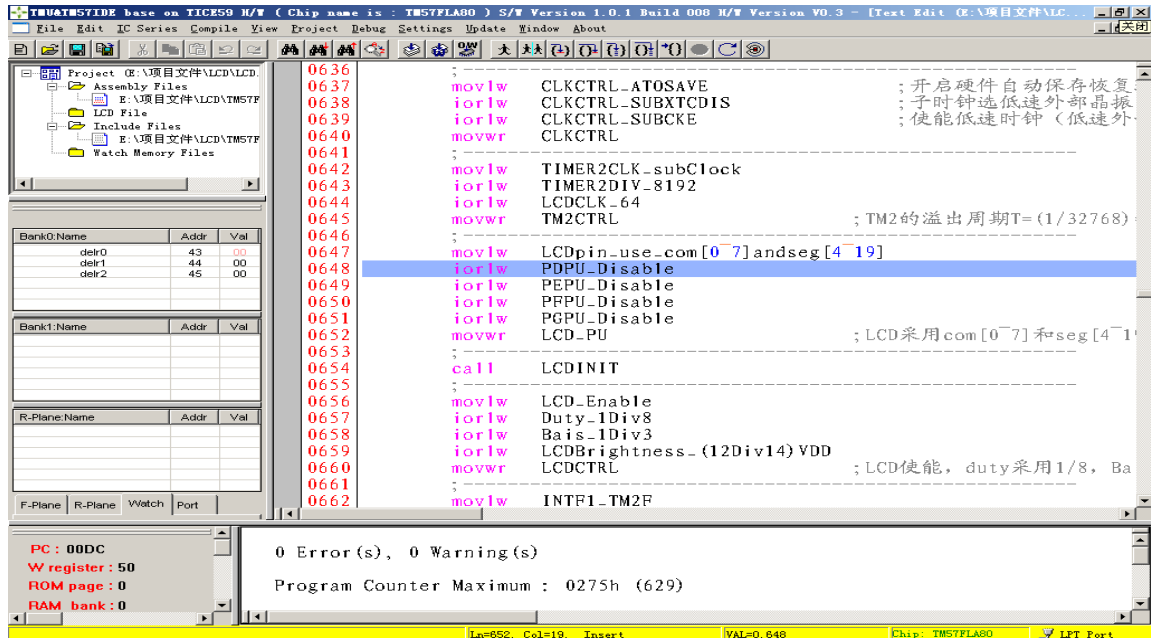
C2	s17 and c0	BIT2 of 30H =1
C3	s17 and c3	BIT3 of 30H =0
C4	s17 and c4	BIT4 of 30H =1
D0	s16 and c0	BIT0 of 2fH =1
D1	s16 and c1	BIT1 of 2fH =0
D2	s16 and c0	BIT2 of 2fH =1
D3	s16 and c3	BIT3 of 2fH =0
D4	s16 and c4	BIT4 of 2fH =1
E0	s15 and c0	BIT0 of 2fH =0
E1	s15 and c1	BIT1 of 2fH =1
E2	s15 and c0	BIT2 of 2fH =0
E3	s15 and c3	BIT3 of 2fH =0
E4	s15 and c4	BIT4 of 2fH =1

As such, when displaying a letter S is desired, simply configure the RAM data of these 25 pixels according to the above description. From this point on, please refer to the `WRITE_dat_1` subroutine in the `DEMO` program for the details of the latter part of the program.

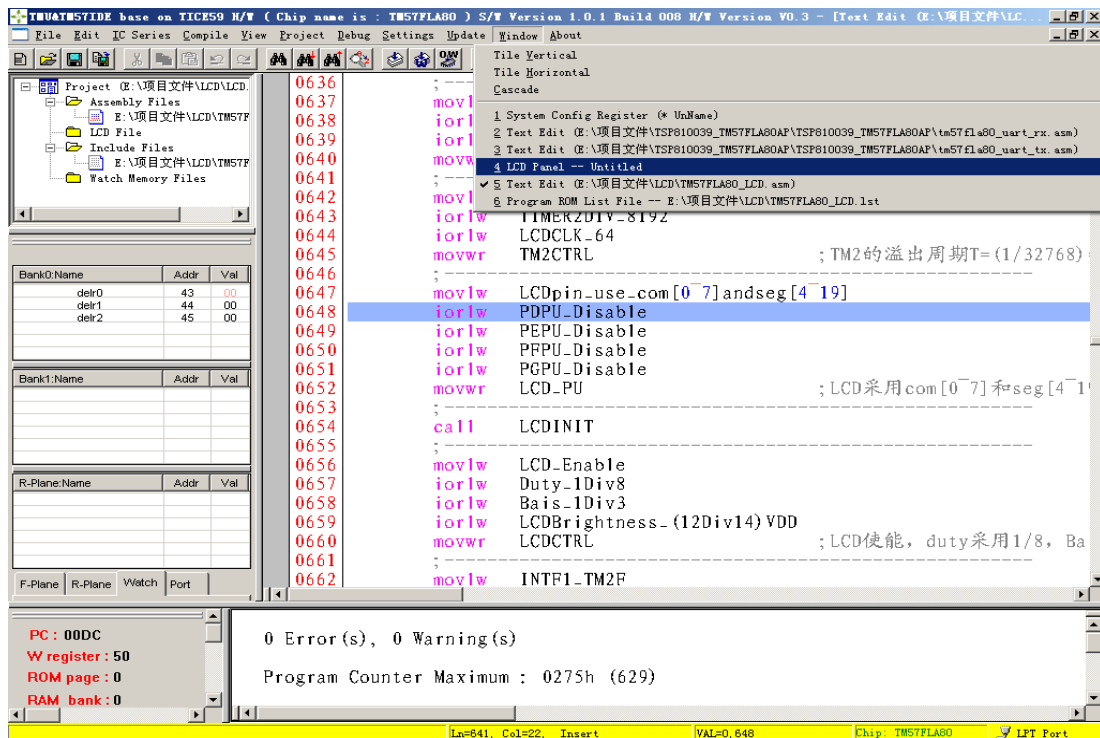
## 04. The user guide of the LCD panel emulator

## 1. Editing a LCD pattern on the LCD panel emulator

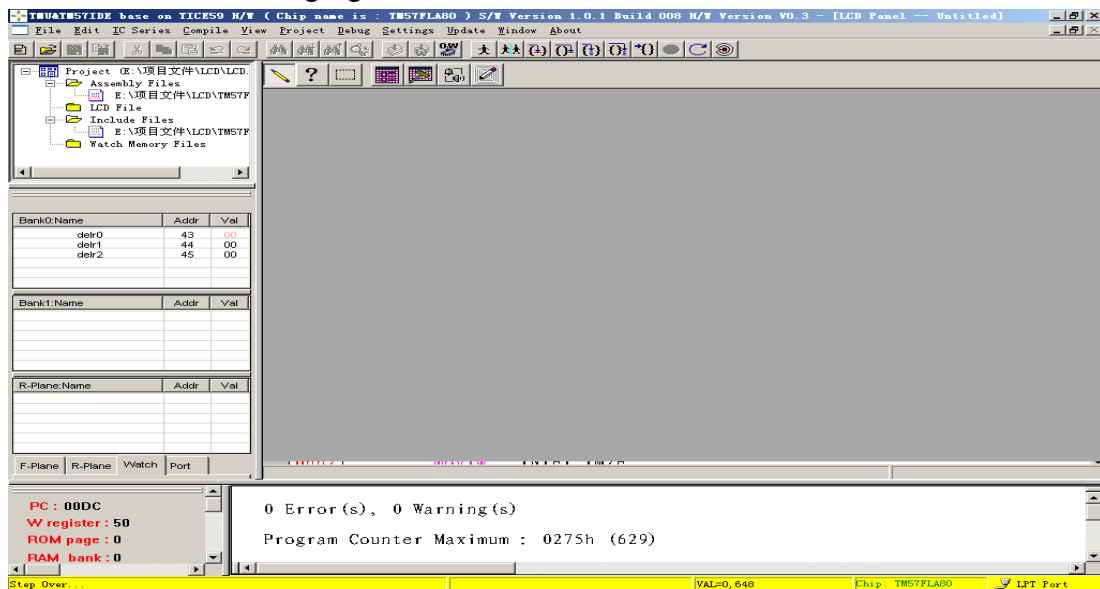
1) Open the LCD panel emulator as shown in the following Figure:




2) Click "Window" function on Menu bar, as shown in the following figure:

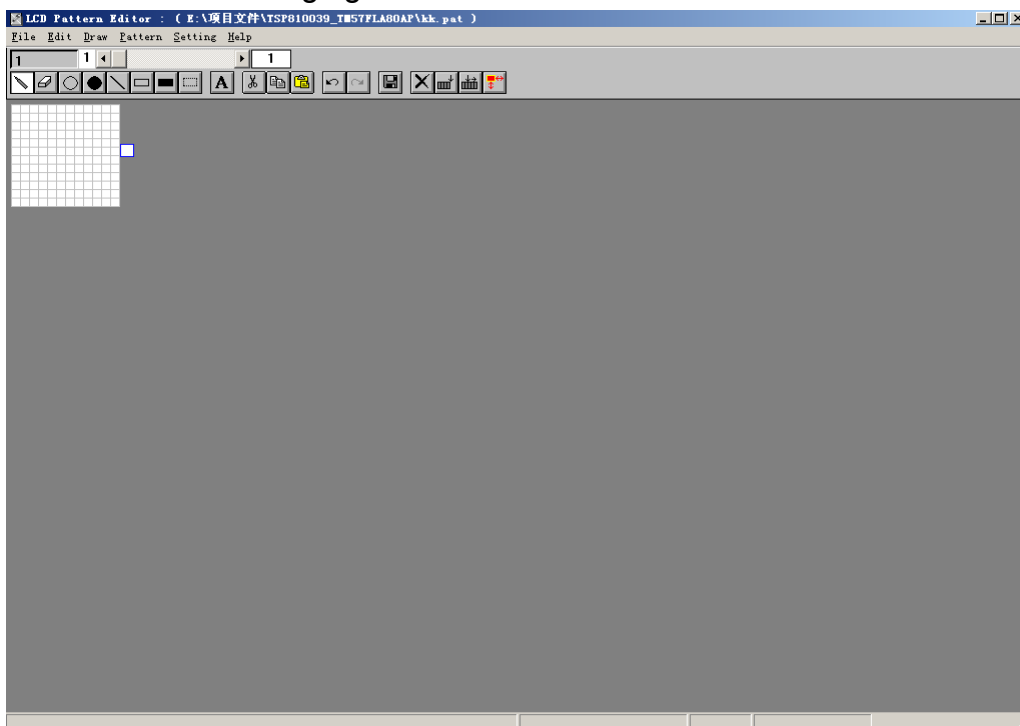



- 3) Select "4. LCD panel--Untitled", TICE59 will open the LCD Panel emulator as shown in the following figure:

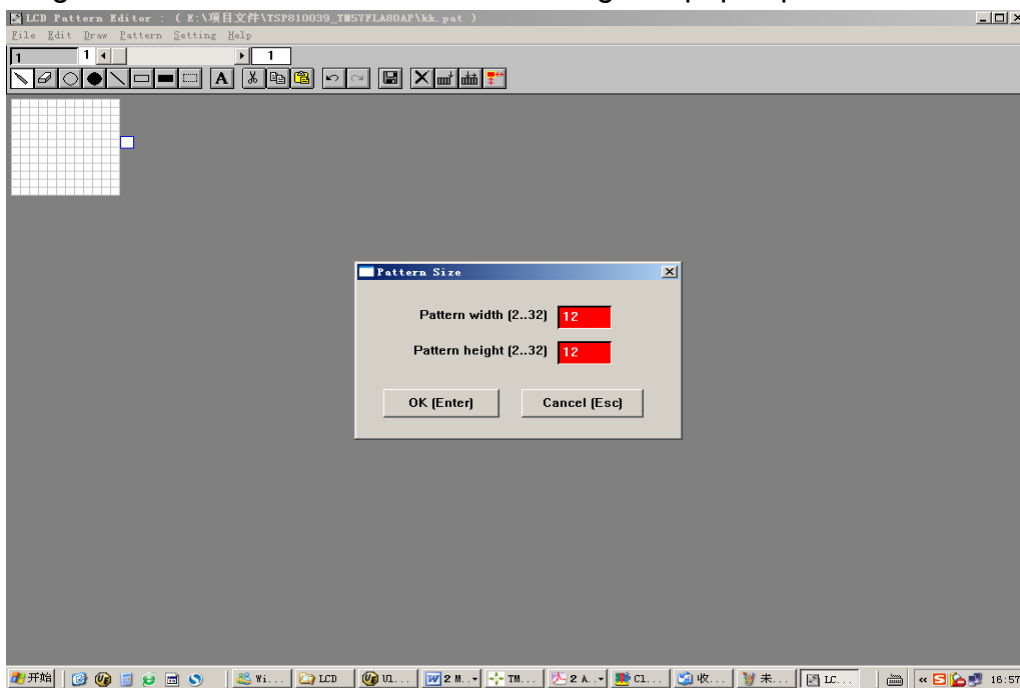





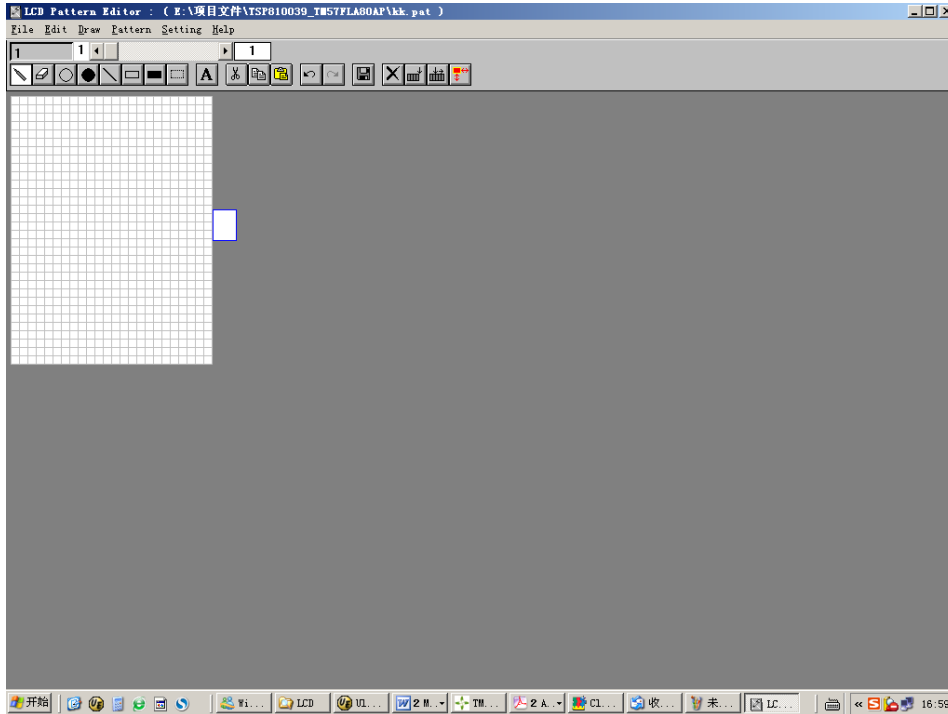
- 4) Click on the  button will enter the LCD Panel library editing window as shown in the following figure:




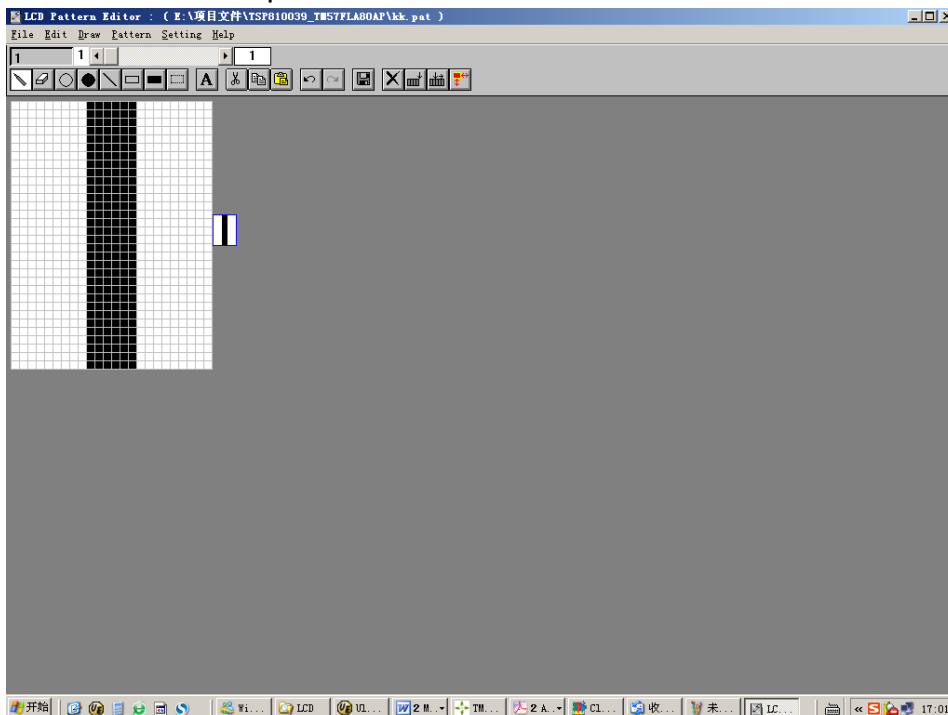
- 5) Single click on the  button and a dialog box pops up as follows:





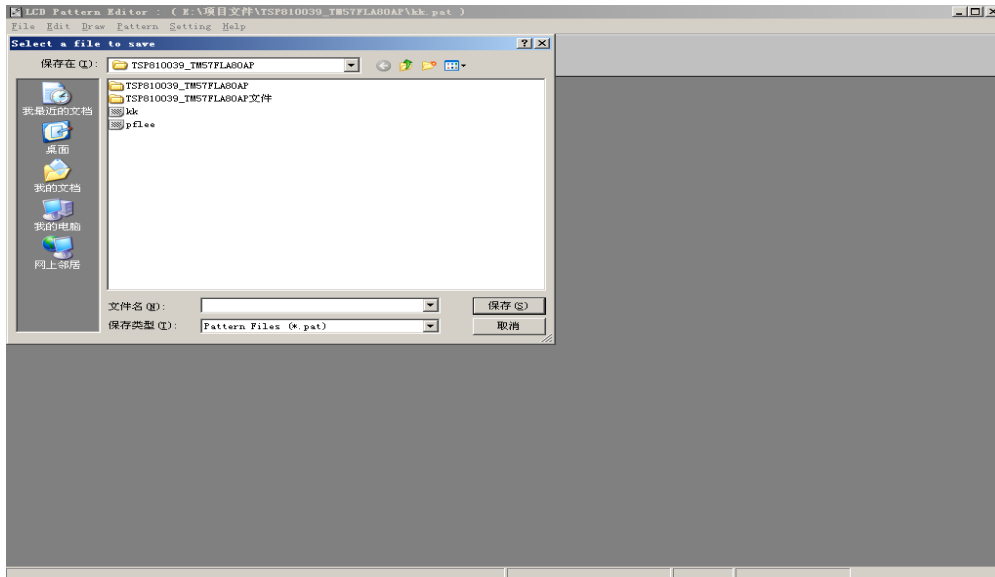
- 6) Change the grid data of width and height in the dialog box to 24 and 32 respectively. Then, Single click on the  button. Observe the change of the interface as shown in the following figure:





- 7) Click on the  button. The user can edit the LCD pattern in the library editing interface. The edited pattern is as below:

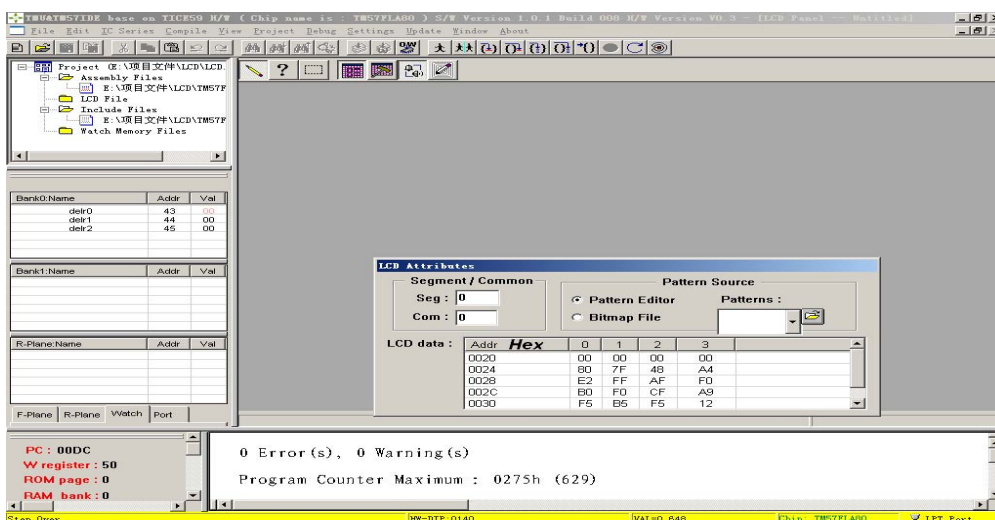


- 8) Click on the  ( save ) button in the tool bar. Then, the drawn patterns will be saved. If this is the first time edit, a dialog box as follows will pop up after clicking on the  save button:







- 9) Enter file path and file name in the above dialog box. After clicking “Save,” the drawn patterns will be saved.
- 10) If another pattern needs to be drawn, simply click the  button in tool bar and repeat steps 7, 8, 9. Of course, if deleting a pattern is needed, simply click on the  button once.

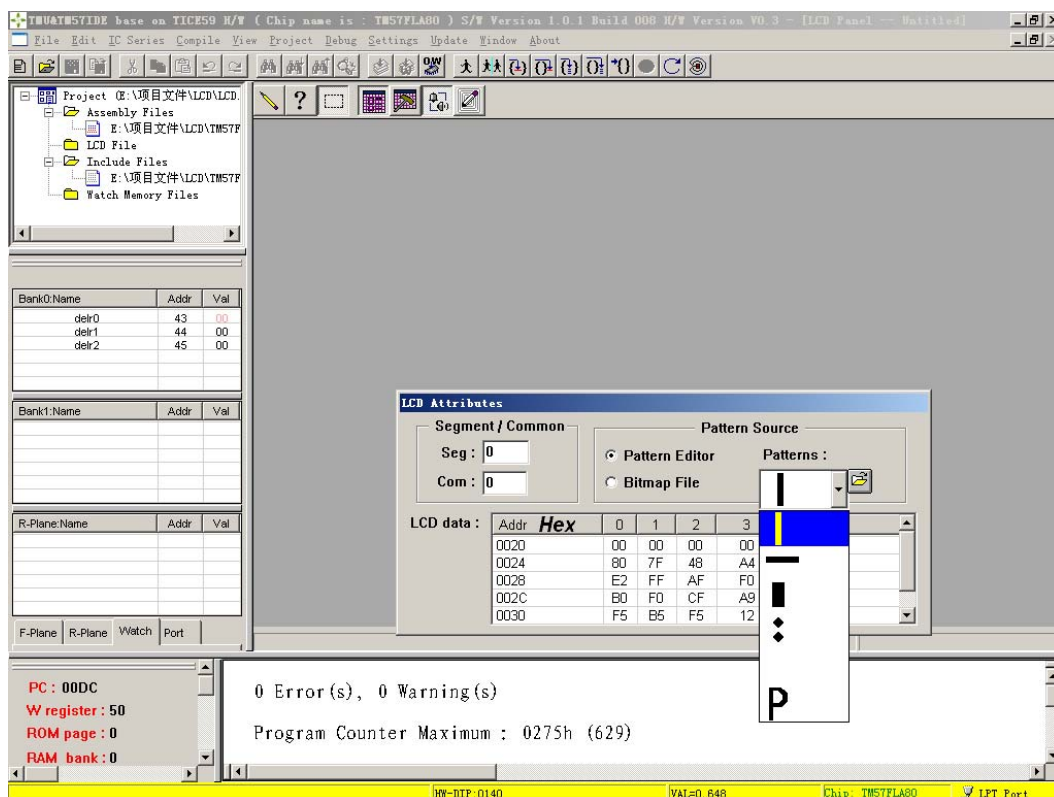
- 11) Click on the  button. A dialog box pops up as follows:




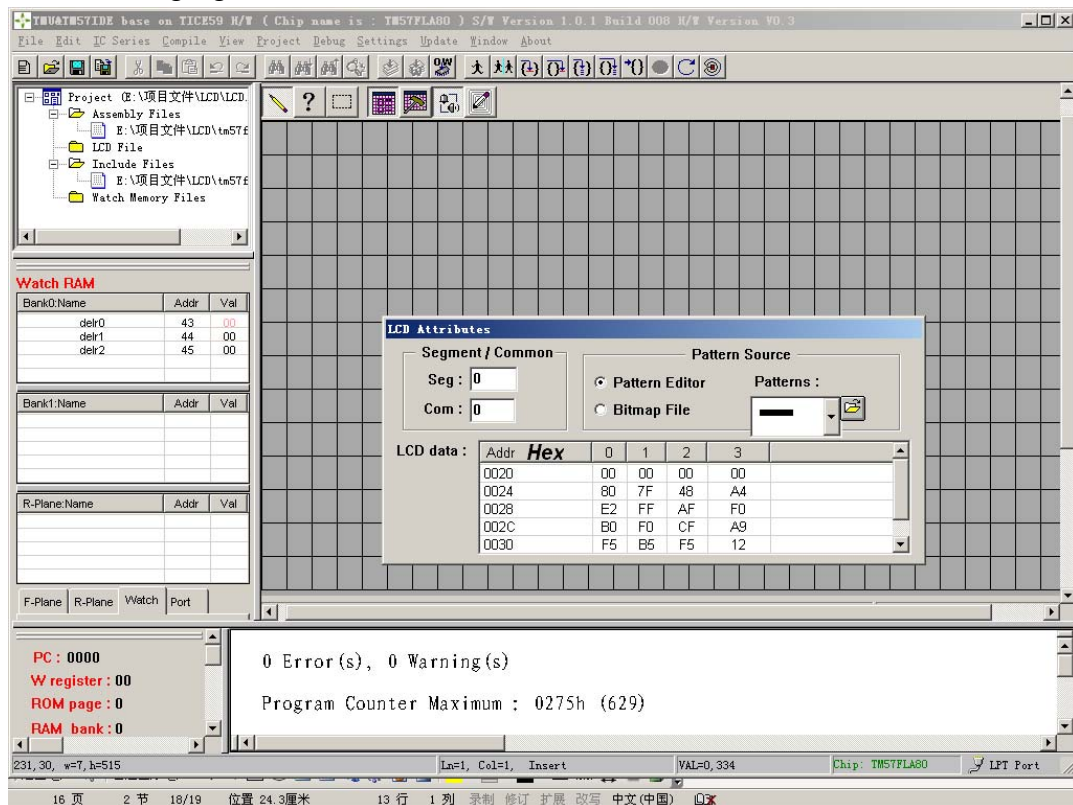
12) Select "Pattern Editor" option  so


as shown in the figure., Then, click on the  button to load the existed pattern file into the editor. If there is patterns in the loaded file, the patterns

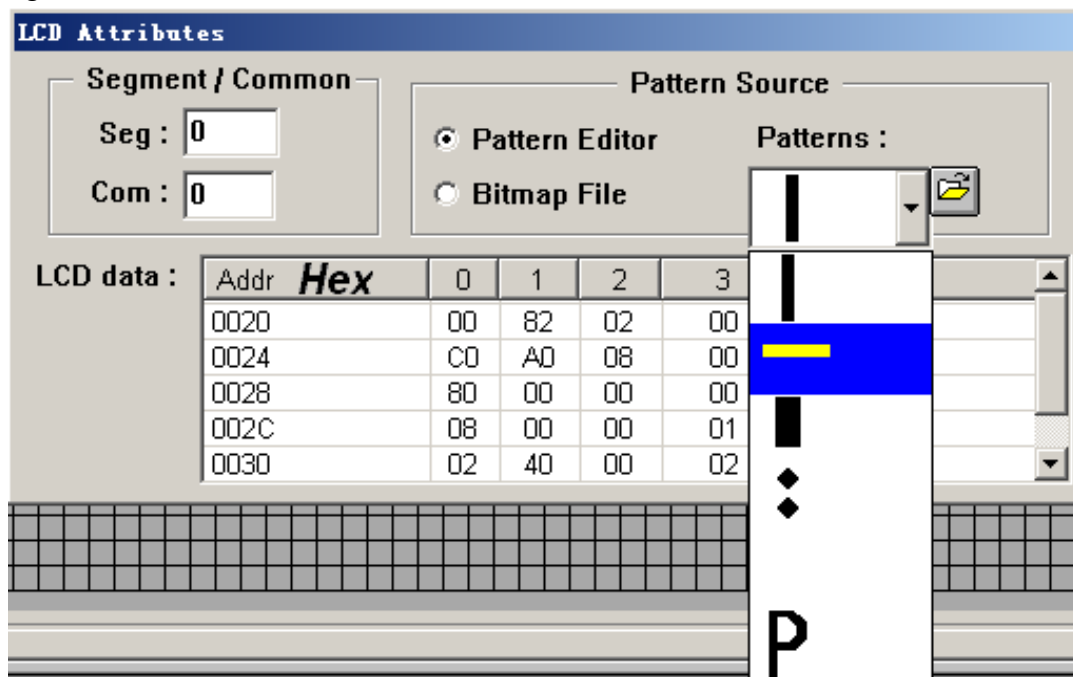
shall show in  on the left of . Bottom patterns click on the  button Uill show all patterns shown in the following figure:




- 13) Single click on the  button ,the pattern editor will display grid as shown in the following figure:

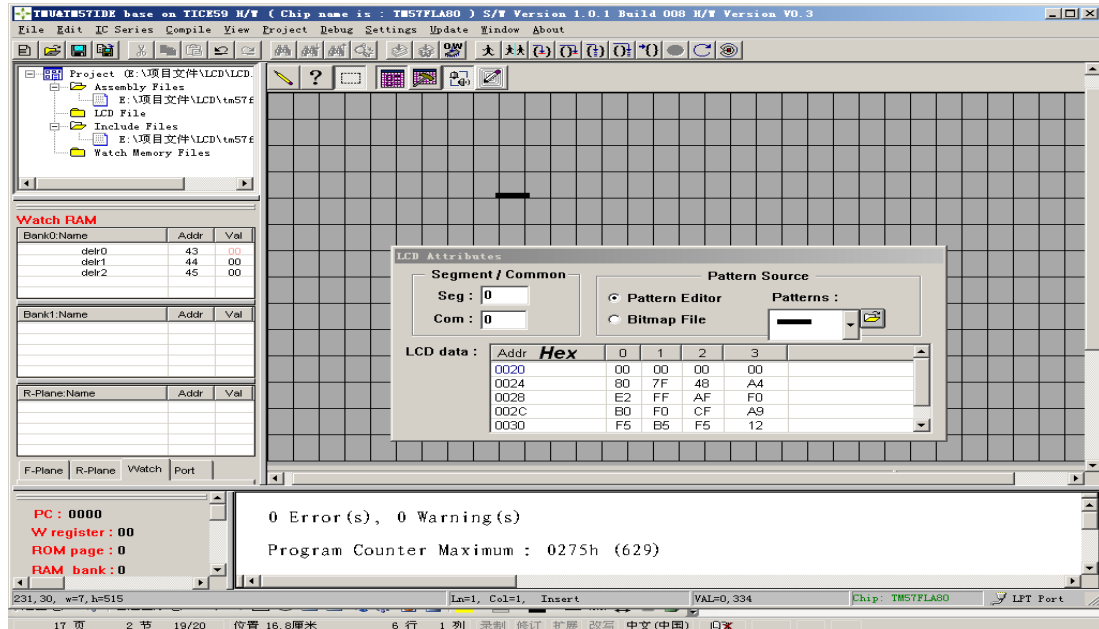



- 14) Click on the  button to select the desired patterns as shown in the following figure:

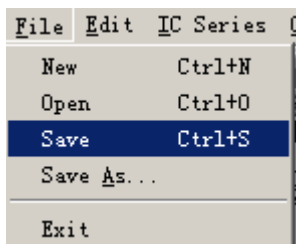



15) Click on the left mouse to select the desired pattern.

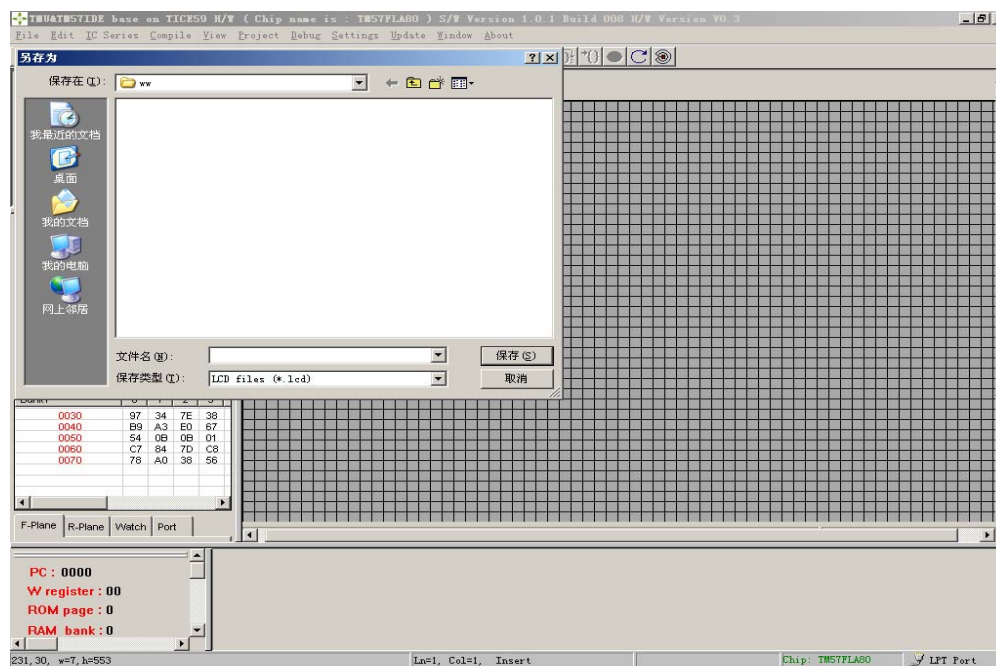
16) Click on the  button so that the desired pattern will be marked as “picked.”. Click on the left mouse at an appropriate location on the grid area to place the desired pattern on the grid PLANE as shown in the following figure.



17) If adjusting the position of this pattern is required, click on the  button. Then, move the cursor to the pattern need to be adjusted. The shape of the cursor will turn into a graphic with 4 outward arrows, which indicates that the pattern is in a state that can be dragged. Click on the left mouse and hold and drag the pattern to the desired position. Then, release the cursor and the position of the pattern is changed.

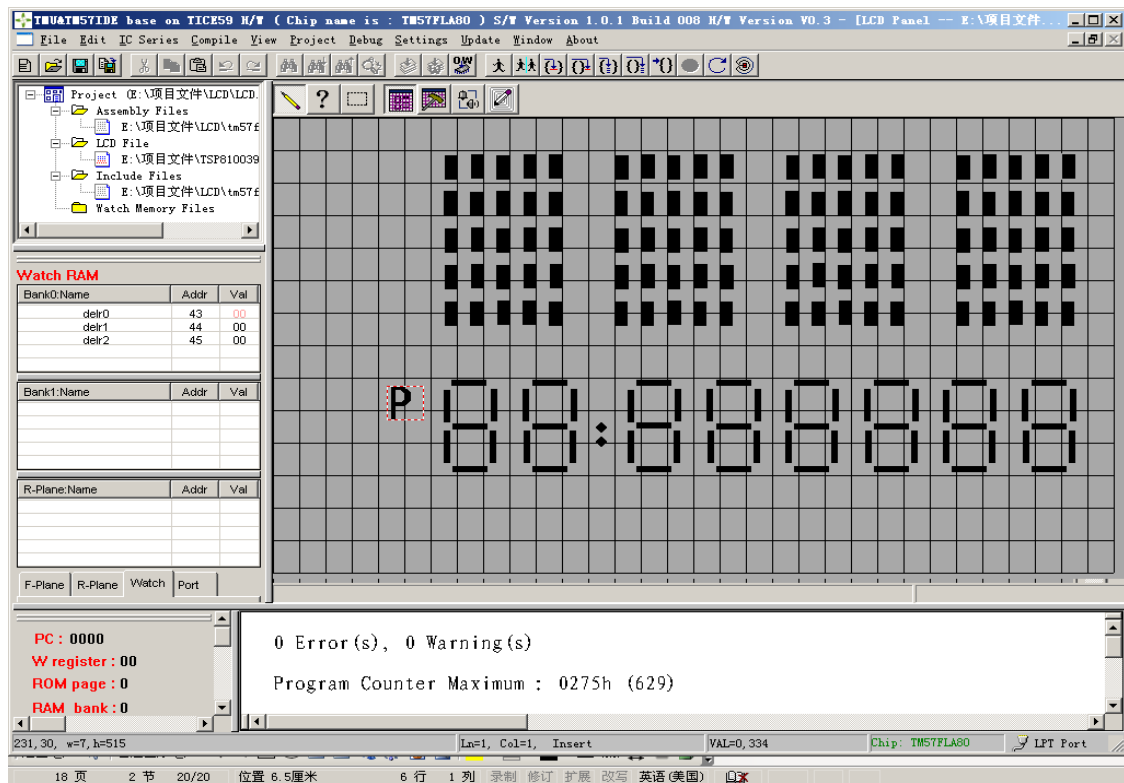






- 18) Click on  to save the LCD pattern file. If this is a first time to save, a dialog box as shown in following figure pops up.



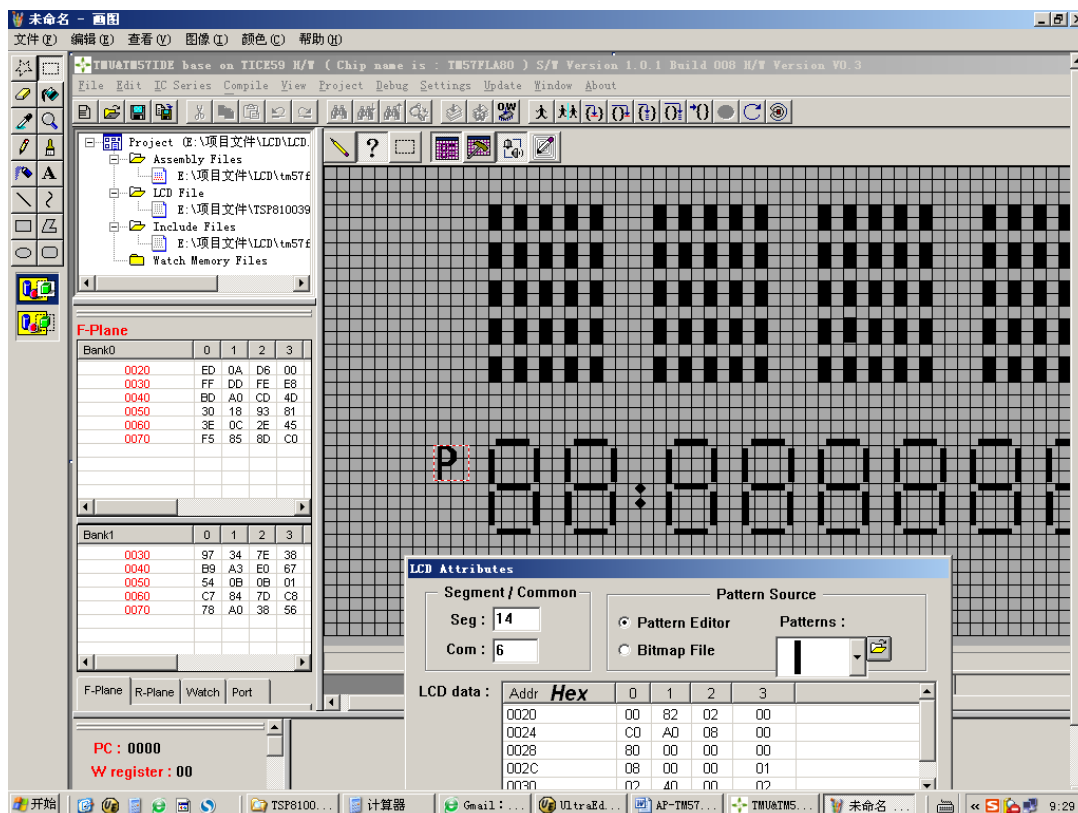
Enter the path and file name to save the LCD pattern file.

- 19) Repeat steps 14~18 to complete the LCD pattern layout as shown in the following figure.

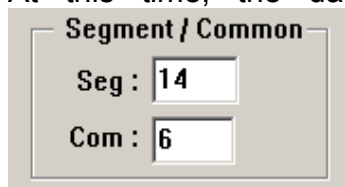



- 20) Click on the  button to edit the COM and SEG data of each pattern. Move the cursor to the top of "P" and click on the left mouse. The letter "P" will display . Then, Double click on  or click on the  button directly. The LCD attribute window will pop up:

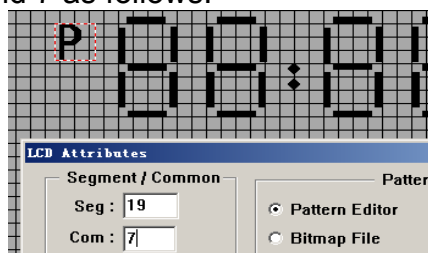




At this time, the data of Seg and Com will show in the window



, are the corresponding SEG and COM values to the pattern, . According to the LCD panel diagram, we change these two values to 19 and 7 as follows:



As such, the SEG and COM properties of pattern, , are changed.

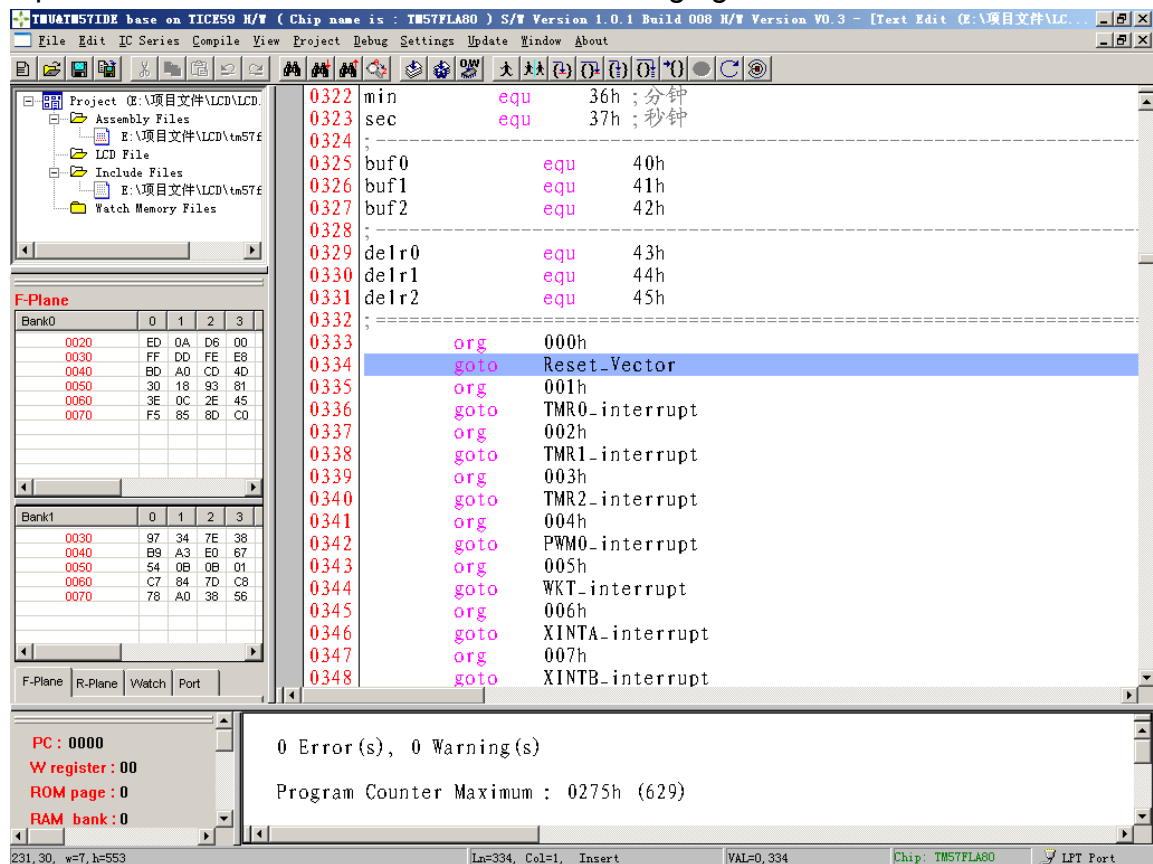
- 21) Repeat the action of the 20<sup>th</sup> step to set up the corresponding Seg and Com values of the remaining patterns in the grid area.

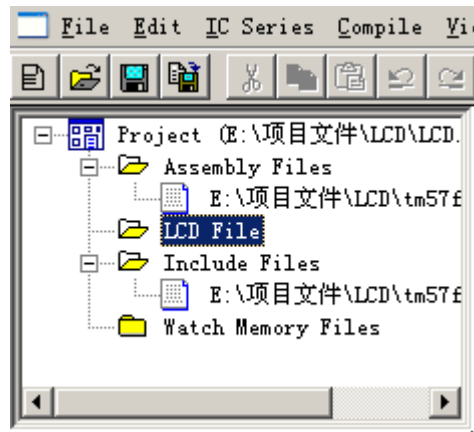


At last, click on the button to exit the LCD attribute window. This way, a complete LCD panel diagram is built.

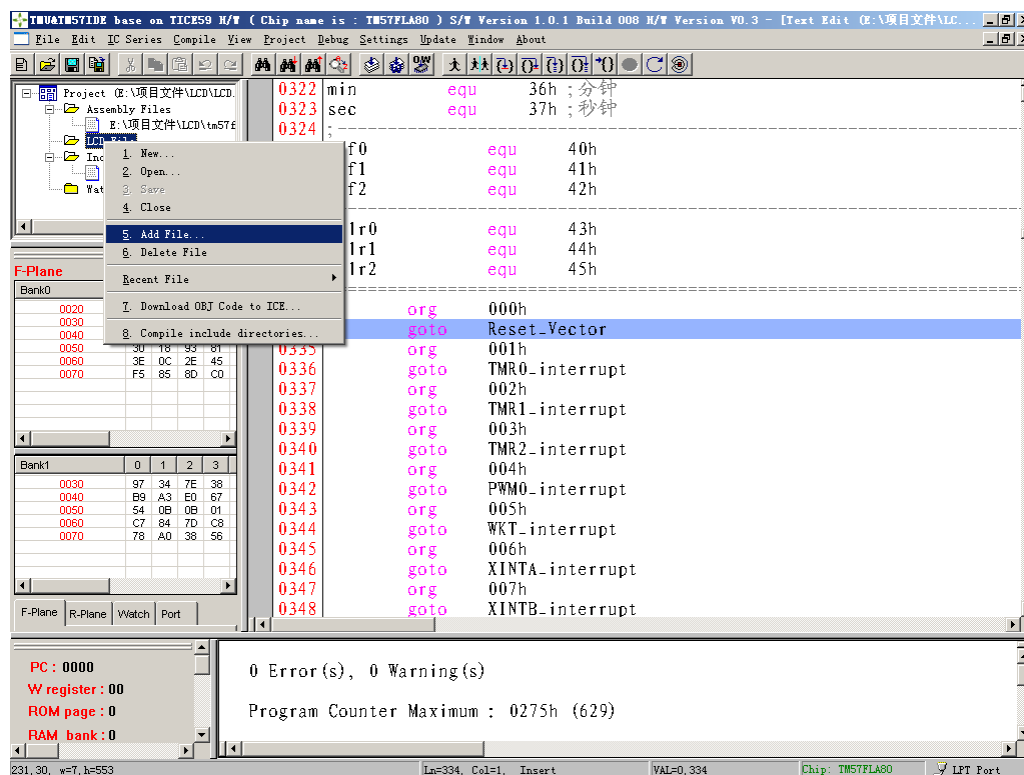
## 2. How to use the LCD panel diagram in TICE59 IDE.

- 1) Open the TICE59 IDE as shown in the following figure:

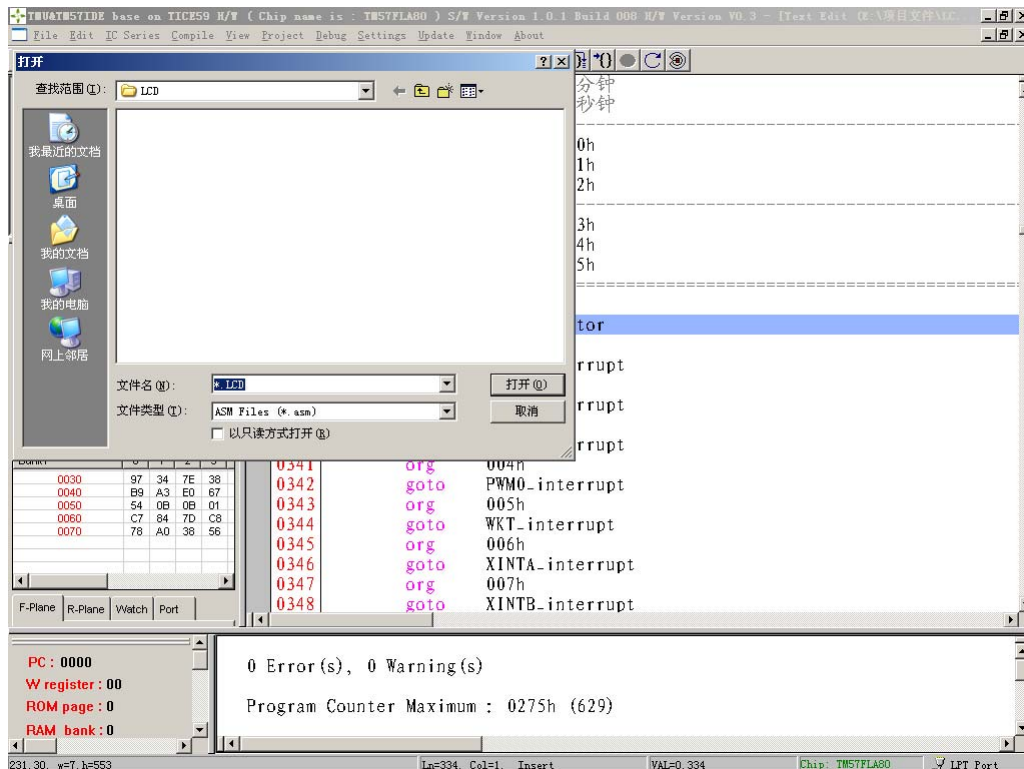




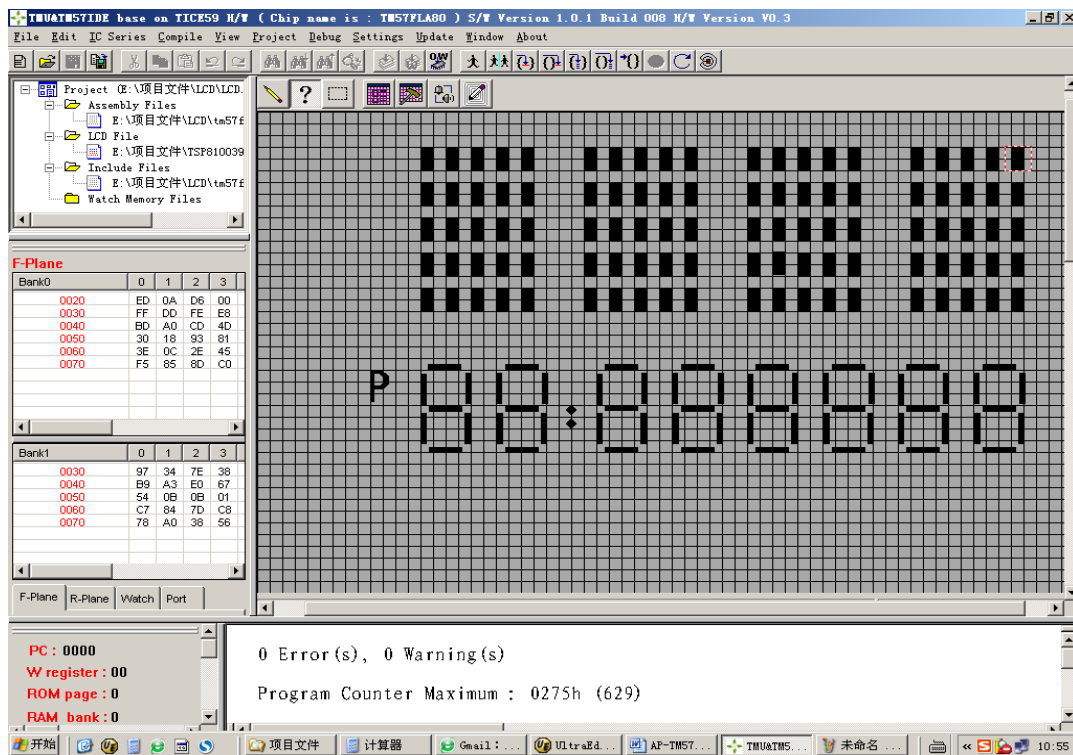
- 2) Click on “LCD file” in  on the left-top window. Then, click the right bottom as shown in the following figure:



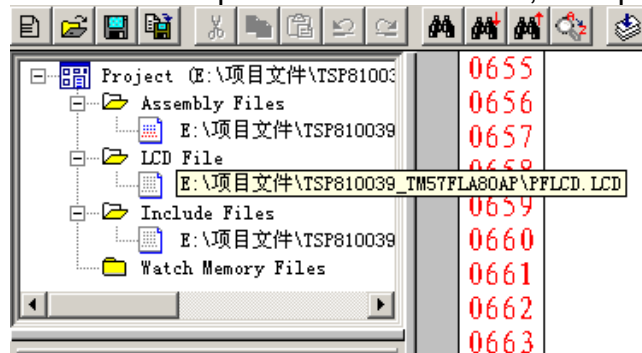
- 3) Move the cursor to the “5 Add File” item and click on it; a dialog box as shown in the following figure pops up:



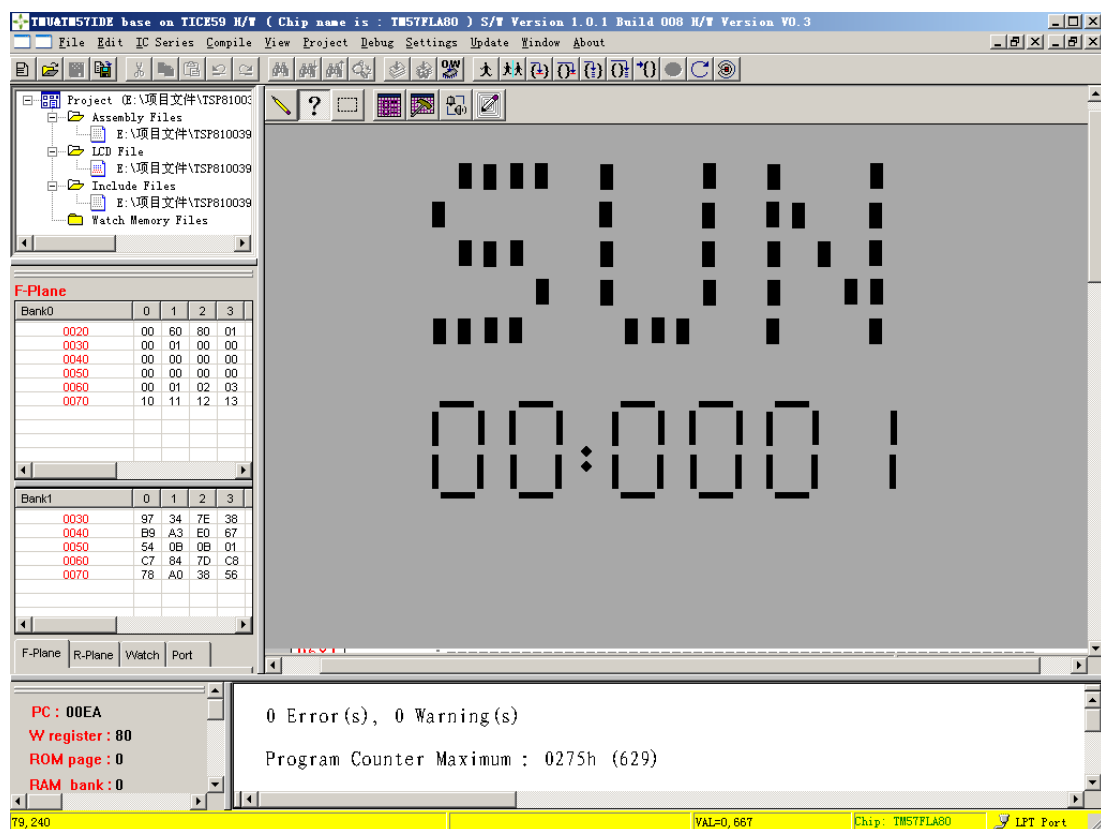
- 4) Load the LCD panel diagram built before into the IDE and open it up as shown in the following:



- 5) Execute the Assembly code after it was compiled and downloaded, then pause.



Double click the "LCD file" .  
to open The LCD panel diagram displays as follows:



**Note:** the LCD panel diagram can only update its display in single step mode. It will not update display during the free run mode.